JUL 11 1944

INDEX NUMBER

Vol. 24 JUNE, 1944 No. 6

Medical Library

THE JOURNAL OF PEDIATRICS

A MONTHLY JOURNAL DEVOTED TO THE PROBLEMS AND DISEASES OF INFANCY AND CHILDHOOD

Official Organ for
THE AMERICAN ACADEMY OF PEDIATRICS

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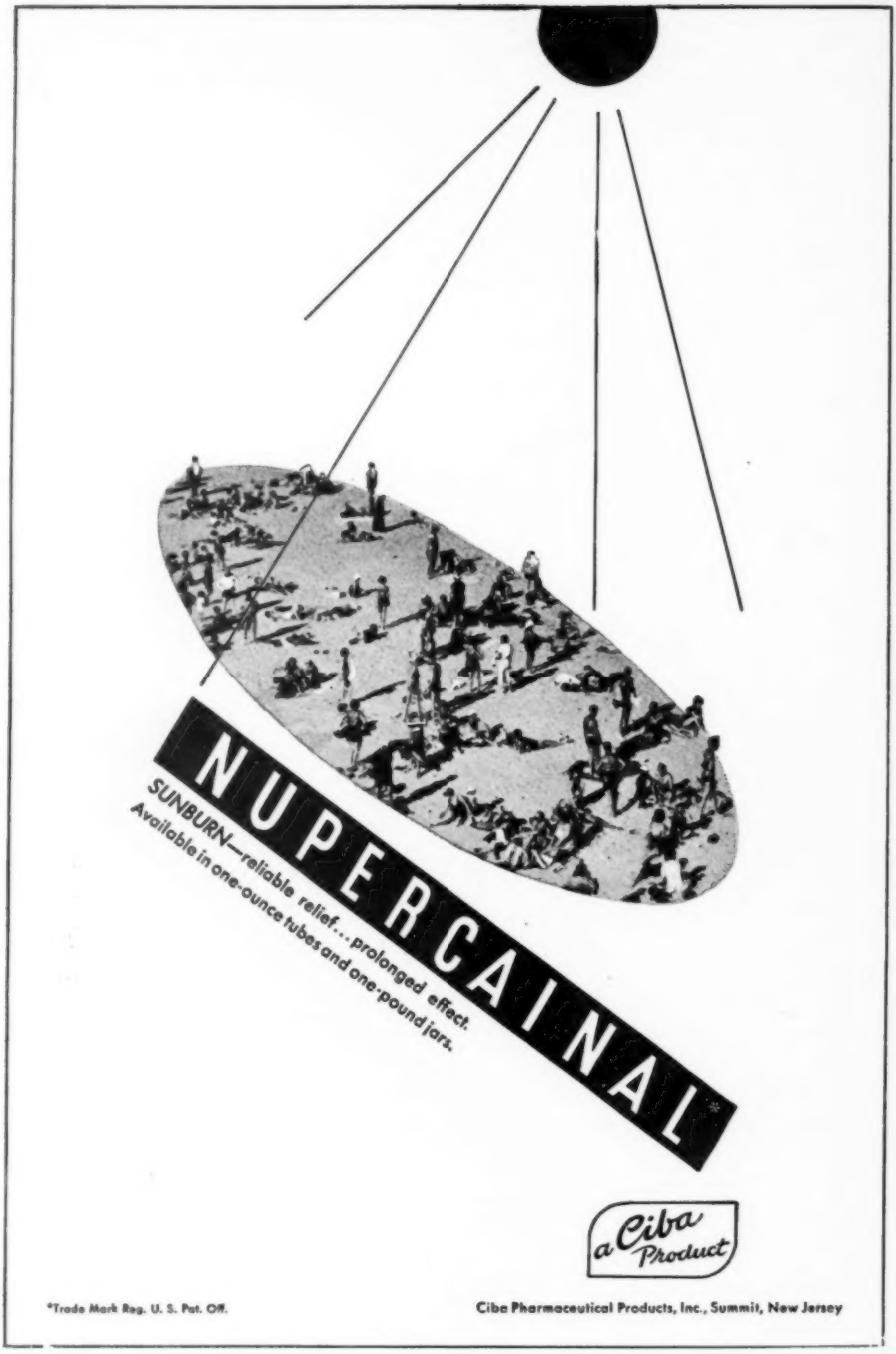
TABLE OF CONTENTS ON 3rd COVER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Vol. 24, No. 6, June, 1944. The Journal of Pediatrics is published monthly by The C. V. Mosby Company, 3523 Pine Blvd., St. Louis 3, Mo. Subscription price: United States, its possessions, Pan-American Countries, $8.50 a year; Canada, $10.00 (Canadian Currency); Foreign, $9.50. Entered as Second-Class Matter at Post Office at St. Louis, Mo., under Act of March 3, 1879. Printed in the U. S. A.

The Journal of Pediatrics

VOL. 24 JUNE, 1944 NO. 6

Original Communications

A COMPARISON OF NEWBORN INFANTS WITH ERYTHROBLASTOSIS FETALIS WITH THOSE BORN TO DIABETIC MOTHERS

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THE purpose of the present investigation is to point out that the syndrome seen in infants with erythroblastosis fetalis is similar in many of its features to that observed in some infants whose mothers either have diabetes mellitus or develop diabetes later in life. Normoblasts have been found in large numbers in the peripheral blood and in the liver of infants born to diabetic mothers.[1, 2] Cardiac hypertrophy has also been described in infants born to diabetic mothers and in those with erythroblastosis fetalis.[2-7] Liebegott[3] found abnormally high levels of glycogen in the myocardium of infants with hydrops fetalis and this was confirmed by Benecke[4] in an infant with icterus gravis. Excess glycogen in the heart of an infant born to a diabetic mother has been recorded by Hurwitz and Irving.[8] Besides the hepatic and cardiac changes there also sometimes occurs a hyperplasia of the islands of Langerhans, first described in infants with erythroblastosis fetalis by Liebegott[3] and later confirmed by the careful studies of Potter, Seckel, and Stryker.[9] The hyperplasia of the islet tissue of the pancreas in infants born to diabetic mothers has been known since the report by Dubreuil and Anderodias[10] in 1920 and has been confirmed by many others. The presence of excessive hepatic erythropoiesis, cardiac hypertrophy, and hyperplasia of the islands of Langerhans in a single individual, which Liebegott demonstrated in infants with hydrops fetalis, has been observed also by Miller and Wilson[2] in infants born to diabetic mothers. The latter investigators also found that the cardiac, pancreatic, and hepatic changes occurred in infants born to mothers who developed diabetes later in life.

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MATERIAL

The histories of 146 infants born to diabetic mothers in the Boston Lying-in Hospital,* the New Haven Hospital, and the New York Hospital during the past decade and a half have been reviewed. Only twenty of the 146 infants were included in the present study, since they were the only infants for whom there were pertinent data in the form of hematologic, Rh, or post-mortem studies.

Thirty-six infants make up the group with erythroblastosis fetalis. Thirty-one had red blood cell counts less than 3.5 millions per cubic millimeter of blood in the first three weeks of life and eighteen of the thirty-one had marked jaundice. Two of the thirty-six infants had severe icterus with normoblastemia but without anemia; in one of these cases the mother's blood was Rh negative and had appreciable isoagglutinins, while the blood of the other mother was not tested for the Rh factor. The diagnosis of erythroblastosis fetalis was made in three infants from the autopsy findings (Table IV, Cases 2, 6, and 8). The blood of the mother in Case 8 was Rh negative; the two remaining mothers were not tested. All thirty-six infants were observed in the New Haven Hospital during the past ten years. All but one of the infants were cared for on the Pediatric Service.

The serologic tests for syphilis on the mothers' blood were all negative in both the infants born to diabetic mothers and those with erythroblastosis fetalis.

RESULTS

Hematologic Studies.—There were twenty-two infants born to diabetic mothers on whom normoblast counts were made. Eleven of the twenty-two infants were observed to have more than 5,000 normoblasts per cubic millimeter of blood at some time during the first few days of life. The results of the blood studies on the eleven infants with high normoblast counts are shown in Table I. The large numbers of immature red blood cells in the circulating blood of these infants are comparable to those seen in newborn babies with erythroblastosis fetalis. In five instances, Cases 1, 2, 4, 7, and 9, there were more than 30,000 immature red blood cells per cubic millimeter of blood. The results of the blood studies indicate that approximately one-half of the infants born to diabetic mothers may be expected to have normoblastemia. This high incidence of normoblastemia parallels the incidence of excessive erythropoiesis in the livers of infants on whom autopsies were performed.[2]

The red blood cell count in infants born to diabetic mothers does not follow the pattern of the counts in babies with erythroblastosis fetalis. In the latter, profound and rapidly developing anemia is the rule. In

*We are greatly indebted to Dr. Frederick C. Irving, Visiting Obstetrician at the Boston Lying-in Hospital, Dr. H. J. Stander, Obstetrician and Gynecologist in Chief, and Dr. S. Z. Levine, Pediatrician in Chief, of the New York Hospital, for permission to present the data on infants born to diabetic mothers from their respective services.

TABLE I

NORMOBLASTS AND RED CELL COUNTS IN BLOOD OF ELEVEN INFANTS BORN TO DIABETIC MOTHERS

CASE	DAY OF LIFE																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		4.4*					3.2					2.2		1.7			
		—					—					—		—			
		44.															
2	7.0		7.6	7.5		7.8		6.6			7.8						5.8
	—		—	—		—		—			—						—
	60.		52.	29.		6.2		6.7			6.4						0
3		7.4		5.9		5.5											
		—		—		—											
		12.		1.0		0.4											
4	6.0	5.6	6.0	6.1					6.7		6.5						
	—	—	—	—	—				—		—						
	30.	2.4	3.8	0.3	0												
5						5.8		4.5			6.2						
						—		—			—						
						6.4		6.3									
6				†													
	—	—	—	—													
	11.	7.5	3.8	0.2													
7		4.3‡															
		—															
		53.															
8	6.0	7.1		5.7‡													
	—	—		—													
	14.	18.		7.0													
9		5.0	5.1‡														
		—	—														
		34.	45.														
10		†‡															
	—																
	9.1																
11			5.3		6.0												‡
			—		—												
			9.0		0.7												

*The red blood cell count is given above line in millions and normoblasts below line in thousands per cubic millemeter. The absence of a figure above or below line indicates that no count was made.

†Normoblasts counted as per 100 white blood cells and the latter estimated at 15,000 per cubic millemeter, average count for infant 6 days of age.[23]

‡Day of death.

the group of thirty-six infants observed in the New Haven Hospital with erythroblastosis fetalis there were thirty-one who had red blood cell counts lower than 3.5 million per cubic millimeter of blood. In contrast to the anemia in these infants is the fact that an erythrocyte count less than 4.0 million was found in only one infant born to a diabetic mother (Table I, Case 1). The failure to find more instances of anemia among infants born to diabetic mothers cannot be attributed to the fact that early death occurred in three infants (Table I, Cases 7, 8,

and 9). Early death is also frequently seen in babies with erythroblastosis fetalis. Nine of the thirty-six in this clinic with this syndrome died before the end of the fourth day and yet the red blood cell count had fallen to less than 3.0 million per cubic millimeter in six of the nine infants. In none of 103 liveborn infants of diabetic mothers observed in the Boston Lying-in Hospital, New Haven Hospital, and New York Hospital was anemia diagnosed clinically as is so frequently done in infants with erythroblastosis fetalis. The anemia that developed in one infant (Table I, Case 1) requires special comment because this was the only infant in the group of 103 liveborn babies of diabetic mothers who was noted to have marked jaundice. The baby also had splenomegaly, hepatomegaly, and an enlarged heart by x-ray. The clinical diagnosis was erythroblastosis fetalis. Rh studies were not made on the mother. The placenta was examined and found to be normal.

Rh Studies.—The results of the Rh studies in diabetic mothers and mothers of infants with erythroblastosis fetalis are shown in Table II.

TABLE II

DISTRIBUTION OF RH FACTOR IN BLOOD OF DIABETIC MOTHERS AND MOTHERS OF INFANTS WITH ERYTHROBLASTOSIS FETALIS

MOTHERS	TOTAL	Rh+	Rh−	NOT DETERMINED
Diabetic	132	9	1	122
Erythroblastosis fetalis	33	0	21	12

Ten diabetic mothers were investigated and the blood of nine was found to be Rh+ and one, Rh−, a distribution similar to that in the population at large.[11] Twenty-one mothers of infants with erythroblastosis fetalis had Rh determinations and the blood of all was Rh−. The blood of all of their infants was Rh+. Three of the diabetic mothers whose blood was Rh+ gave birth to infants with an excessive normoblastemia, Case 2 in Table I and Cases 7 and 8 in Table III.

Post-Mortem Studies.—In Tables III and IV are shown the results of the autopsy findings in infants born to diabetic mothers and in infants with erythroblastosis fetalis, respectively. The cases in Table III include only those infants born to diabetic mothers who showed evidence of abnormal extramedullary erythropoiesis on histopathologic examination. Table IV includes data on all the autopsies performed on the group of thirty-six infants admitted to the New Haven Hospital with a diagnosis of erythroblastosis fetalis. All of the infants listed in both Tables III and IV were either stillborn or died before the end of the fourth day with the exception of two (Table IV, Cases 11 and 12). Two in Table III (Cases 5 and 12) and one in Table IV (Case 8) were born before symptoms or signs of diabetes were recognized in the mother. In Case 3, Table III, there was some doubt concerning the diagnosis of diabetes in the mother. She had glycosuria but no other evidence of diabetes.

TABLE III

POST-MORTEM OBSERVATIONS ON THIRTEEN INFANTS BORN TO DIABETIC MOTHERS

CASE*	BODY WEIGHT (KG.)	HEART WEIGHT (GM.)†	HYPERPLASIA PANCREATIC ISLETS	ERYTHROPOIESIS	WEIGHT OF ADRENALS (GM.)	JAUNDICE	SITES OF BLEEDING	REMARKS
1 (S)	3.9	*35*‡	Present	Liver, spleen	--	0	Heart, lateral ventricle of brain, petechiae in viscera	Hydrothorax, ascites, congestion of viscera
2 (S)	4.3	34‡	Numerous, large	Liver	18	0	Subarachnoid	Cleidotomy
3 (S)	5.0	35	Autolysis	Liver	--	0	--------	Glycosuria in mother, ? diabetes mellitus
4 (S)	5.1	*49*	Present	Liver	--	0	--------	
5 (S)	5.9	29	----	Liver	--	0	--------	Edema, congestion of viscera; mother subsequently developed diabetes
6 (N1)	3.7	26	Present	Liver	--	0	Petechiae in viscera	Edema, bronchopneumonia, congestion of viscera
7 (N2)	2.3	18‡	Present	Liver	--	0	Multiple ecchymosis, myocardium, liver	Eosinophilic infiltration of pancreas
8 (N2)	2.6	‡§	----	Liver	--	0	--------	
9 (N2)	2.6	15	Very prominent	Liver	--	0	Subarachnoid, peritoneum	
10 (N3)	3.8	*70*	Present	Liver, spleen	--	0	Subarachnoid, cerebellum, lungs	Tentorial tears
11 (N3)	4.3	*38*‡	"Increase"	Liver	12	0	--------	Congestion of viscera, renal infarcts
12 (N3)	4.1	*36*	----	Liver, stomach	14	0	Subarachnoid, massive intracerebral and cerebellar, lung, bladder, kidney, gastric mucosa, thymus, adrenals, pituitary	Mother developed diabetes 5 years later
13 (N4)	4.9	40	Present	Liver, spleen	--	0	Peritoneum, pericardium	Edema, bronchopneumonia

*Under Case (S) = stillborn and (N1) = neonatal death on first day of life, (N2) on second day of life, etc.

†Heart weights that are in italics indicate cardiac hypertrophy.

‡Cardiac glycogen: Case 7, 1.01 Gm. per cent; Cases 1 and 2, large amounts by Best's carmine stain; Case 8, no glycogen by Best's carmine stain.

§Heart was very large by x-ray; was not weighed at autopsy.

TABLE IV

POST-MORTEM OBSERVATIONS ON TWELVE INFANTS WITH ERYTHROBLASTOSIS FETALIS

CASE*	BODY WEIGHT (KG.)	HEART WEIGHT (GM.)†	HYPERPLASIA PANCREATIC ISLETS	ERYTHROPOIESIS	WEIGHT OF ADRENALS (GM.)	JAUNDICE ‡	SITES OF BLEEDING	REMARKS
1 (S)	3.2	*32*§	++	+++ Liver, spleen, kidney	30	0	Peritoneum (200 c.c.), intestines	Ascites, edema, hydrothorax (bilateral); delivered one month before expected date of confinement
2 (N1)	2.8	*35*	+++	++++ Liver, skin, thymus	25	+	Peritoneum (200 c.c.)	Edema; delivered four months before expected date of confinement
3 (N1)	3.2	22	---	Liver, spleen	12	+	Intraventricular of brain, petechiae of brain, thymus, epicardium	Ascites
4 (N1)	4.7	*60*	+++	++++ Liver, spleen	12	+	Petechiae of intestines, stomach, pleura, skin, renal pelvis	Edema
5 (N2)	3.1	20	---	++ Liver	--	+ K	Kidney	
6 (N4)	3.2	*35*	+	+ Liver	8	+ K	Lung	
7 (N2)	4.3	35	++	++++ Liver	12	+	Occipital lobe of brain	Ascites, hydrothorax, necrobiosis of brain
8 (N2)	4.4	*50*§	++++	+++ Liver, spleen, heart	17	0	------	Eosinophilia of pars anterior of pituitary; mother later developed diabetes
9 (N3)	2.1	16	++	++++ Liver, spleen	6	+ K	Lung	Edema appeared several hours after delivery
10 (N3)	3.2	20§	+	++ Liver	--	+ K	Lung, spinal cord, uretal orifices	
11 (N21)		23	0	+ Liver	--	0	None	Died with R.B.C. count of 0.64 million per c.mm.
12 (N30)	1.5	15	---	0	3	+	Subdural	Periportal fibrosis

*Under Case, (S) = stillborn and (N1) = neonatal death on first day, etc.
†Heart weights that are in italics indicate cardiac hypertrophy.
‡Under jaundice + indicates an icterus index over 100 and K = kernicterus.
§Cardiac glycogen: Case 1, 0.17 Gm. per cent; Case 8, 1.6 Gm. per cent; Case 10, 0.11 Gm. per cent.

Time of Death.—Early death is common to infants born to diabetic mothers and those with erythroblastosis fetalis. Among the liveborn infants most of the deaths in both groups occurred in the first three or four days of life and the incidence of stillborn and macerated fetuses is also very high. This is an important observation because the tissue changes to be described are temporary, and in an infant who lived for only two days they will differ appreciably from those seen in an infant who lived for two weeks.

Birth Weight.—An increased birth weight among some infants born to diabetic mothers is well recognized. According to Javert[12] the gestation period of infants with hydrops fetalis is, on the average, a month less than normally expected, and the birth weight of these infants is 1,000 Gm. in excess of normal babies whose gestation period is of a similar duration. The data in Table IV are insufficient to confirm Javert's claim. However, there were six infants, or 18 per cent, weighing over 4,000 Gm. at birth and two infants, or 6 per cent, weighing over 4,500 Gm. among the thirty-three infants with erythroblastosis fetalis with recorded birth weights. Both of these percentages are higher than the rates of 5.5 per cent for unselected infants over 4,000 Gm.[13] and 1.0 per cent for those over 4,500 Gm.[14] While the number of cases is too few to be of statistical significance, it suggests that there is a tendency for infants with erythroblastosis fetalis also to be overweight at birth.

Cardiac Hypertrophy.—The weight of the hearts that were abnormally heavy have been indicated by italics in Tables III and IV. In Table III there were five infants with an excessive cardiac weight (Cases 1, 4, 10, 11, and 12) and in Table IV there were also five (Cases 1, 2, 4, 6, and 8). An abnormal heart weight was diagnosed in these infants according to a formula derived by Miller for calculating heart weight from body weight.[15] In every instance in Tables III and IV in which the diagnosis of cardiac hypertrophy was made, the difference between the observed and calculated weights of the heart was more than three times the standard deviation.

Cardiac Glycogen.—Cardiac glycogen was determined by chemical analysis in Case 7 of Table III, and Cases 1, 8, and 10 of Table IV. The myocardium was examined for glycogen after using Best's carmine stain in Cases 1, 2, and 8 in Table III. There are not sufficient data to comment on the amount of glycogen in these hearts, but the results should stimulate further investigation in other clinics, particularly in the quantitative analysis of this substance, since in Case 7 of Table III and Case 8 of Table IV the glycogen content of the heart seemed increased. It should be pointed out that the mother of the infant in Case 8, Table IV, later developed diabetes.

Hyperplasia of Islands of Langerhans.—The incidence of hyperplasia of the islands of Langerhans is shown in Tables III and IV. No exact measurements of the size of the islands of Langerhans were made in the

present study. Hyperplasia was determined by histologic examination of representative sections of the pancreas taken from both groups of infants. The degree of hyperplasia of the islet tissue of the infants in Table IV was graded by this technique. The results shown in Tables III and IV confirm the presence of hyperplasia of the islands of Langerhans which has been reported to exist in infants in both groups by other investigators. When the pancreatic changes were present, they were not exclusively associated either with macrosomia or cardiac hypertrophy, although, as shown in Table IV, there did seem to be more extensive islet changes in infants with enlarged hearts. There also seemed to be a rough correlation between the amount of hyperplasia of the islet cells and the amount of extramedullary erythropoiesis seen in the infants whose cases are recorded in Table IV.

Extramedullary Erythropoiesis.—From the data in Tables III and IV, it would appear that the extramedullary erythropoiesis was more extensive in infants with erythroblastosis fetalis than in those born to diabetic mothers. The difference may be more apparent than real, since in the latter group of infants the data were largely obtained from the autopsy protocols, while in the infants with erythroblastosis fetalis the data were based on direct observations of histopathologic preparations. The autopsy protocols on the infants born to diabetic mothers may not have revealed the true extent of the extramedullary erythropoiesis, since attention has been focused only recently on the significance of the finding in these infants.

The triad of cardiac hypertrophy, hyperplasia of the islands of Langerhans, and erythropoiesis were found in Cases 1, 4, 10, and 11 in Table III and in Cases 1, 2, 4, 6, and 8 in Table IV.

Adrenal Hyperplasia.—Sarason has called attention to the fact that the adrenals of newborn infants dying with erythroblastosis fetalis are abnormally large.[16] The explanation for the change was not apparent from his post-mortem material. Three infants whose mothers had diabetes mellitus had adrenal weights determined at autopsy (Cases 2, 11, and 12, Table III), and in all three infants both adrenals together weighed more than 10 Gm. In the remaining cases no weights for the adrenals were recorded. The results in the three cases mentioned suggest that in infants of diabetic mothers adrenal enlargement is also present. In Table IV six infants (Cases 1, 2, 3, 4, 7, and 8) had adrenal glands which together weighed more than 10 Gm. Cases 4 and 8 were previously reported by Sarason.

Jaundice.—Marked jaundice, which was noted in only one infant born to a diabetic mother (Case 1, Table I), was observed in nine of the twelve infants listed in Table IV and in twenty-one of the thirty-six infants who made up the total group with erythroblastosis fetalis. Four of the nine infants in Table IV with marked icterus had kernic-

terus. None of the thirteen infants in Table III who were born to diabetic mothers had either jaundice or kernicterus.

Hemorrhagic Diathesis.—Javert[7] states that in some of his cases the diagnosis of "hemorrhagic disease of the newborn" was entertained until blood studies showed large numbers of normoblasts in the circulating blood and a severe anemia. Extravasation of blood into the tissues was a frequent observation in infants observed at post-mortem (Tables III and IV). The amount of bleeding is not recorded in these Tables, but unless classified as petechial in nature, the hemorrhages were large. Large hemorrhages were observed in seven of the thirteen infants born to diabetic mothers in whom autopsies were performed (Table III) and in nine of the twelve infants with erythroblastosis (Table IV).

Edema.—Edema has been recognized as an outstanding characteristic in certain infants with erythroblastosis fetalis. Four of the eleven infants listed in Table IV had edema. Three of the thirteen infants born to diabetic mothers also had edema, but none of them to the extent that the diagnosis of hydrops fetalis had ever been entertained.

DISCUSSION

During the past decade hydrops fetalis, congenital anemia of the newborn infant and icterus gravis have been considered as parts of a single syndrome because they were found to have a familial incidence. Recently Levine and his co-workers[11, 17, 18] have held firmly that the syndrome and its familial pattern are dependent on iso-agglutinins developed in the mother during pregnancy. It has been difficult to reconcile their theory with the fact that about 10 per cent of the mothers are Rh positive, that in some mothers who are Rh negative no iso-agglutinins can be demonstrated in spite of the fact that their infants have erythroblastosis fetalis, and that there is no correlation between the severity of the syndrome in the infant and the antibody content of the maternal serum.

The data presented here show why the isoimmunization theory may not hold in all cases that are diagnosed as erythroblastosis fetalis. Unless all infants without anemia and jaundice are excluded, some infants born to diabetic mothers will be included under the diagnosis erythroblastosis fetalis. Infants born to diabetic mothers rarely have anemia or jaundice but do have large numbers of normoblasts in the peripheral blood and in the extramedullary tissues and are similar to infants with erythroblastosis fetalis in many other important respects. Javert[12] and Hellman and Hertig[6] included infants born to diabetic mothers in their reports on erythroblastosis fetalis. It is not clear from the studies made by Levine and others whether or not the diagnosis of erythroblastosis fetalis was strictly limited to infants with anemia and jaundice. If they did include infants born to diabetic mothers in their series, it would account for the fact that the mothers of some infants with this

syndrome were Rh positive. As has been pointed out by Miller and Wilson[2] and as illustrated by Cases 5 and 12 in Table III, the mother need not have symptoms or signs of diabetes at the time of the infant's birth but may develop them later in life. It would be very difficult, if not impossible, to exclude from the syndrome erythroblastosis fetalis infants who were stillborn or died within a few hours of birth whose mothers had not yet developed diabetes and who were Rh positive, since the premature death of the infant would preclude the diagnosis of anemia and jaundice.

Numerically the offspring of diabetic mothers are sufficient to account for the 10 per cent of infants whose mothers are Rh positive. Diabetic pregnancies are said to occur in one of every 900 hospital deliveries,[19, 20] and the present data show that about 50 per cent of the infants born to diabetic mothers have evidence of abnormal erythropoiesis. It would be conservative to say that one of every 2,500 pregnancies results in a fetus or infant with erythroblastosis because the mother has diabetes. Javert estimates that one infant in every 438 births has erythroblastosis fetalis.[7] Hence, it might be expected that for every five or six infants diagnosed as having erythroblastosis fetalis, one of them might have a diabetic mother. Even if the incidence of erythroblastosis among infants born to diabetic mothers was only one-half of our estimate, the number would be sufficient to account for the 10 per cent of cases diagnosed as erythroblastosis fetalis whose mothers were Rh positive. These estimates do not take into consideration infants born before the onset of symptoms and signs of diabetes in their mothers. In the New Haven Hospital during the past decade thirty-six infants have been diagnosed as having erythroblastosis fetalis. To this number there could have been added five infants with evidence of marked normoblastemia whose mothers had diabetes or subsequently developed it. If this group of five infants had been included under the diagnosis, erythroblastosis fetalis, approximately 10 per cent of the total group of mothers would have been found to have blood that was Rh positive.

Further investigations will be necessary to decide whether or not infants born to diabetic mothers or to mothers who subsequently develop diabetes should be included in the syndrome of erythroblastosis fetalis. The arguments in favor of it are the strikingly similar somatic and visceral changes and the fact that some of the alterations in the various organs and tissues are found almost exclusively in these two groups of newborn infants. Potter, Seckel, and Stryker[9] found that all but ten of forty-three newborn infants with hyperplasia of the islands of Langerhans could be accounted for by these two groups of infants. Miller[15] observed that these same two groups of infants accounted for five out of six cases of cardiac hypertrophy seen in the first week of life. Since infants born to diabetic mothers and those with erythroblastosis fetalis make up probably less than 5 per cent of the autopsy material

in newborn infants, the degree to which the pancreatic and cardiac changes are restricted to these two groups of infants takes on added significance. Against the proposition that infants of diabetic mothers should be included among those with erythroblastosis fetalis is the fact that anemia and jaundice are rarely present.

Two theories suggest themselves to explain the similarities and differences in these two groups of infants. It is possible that the visceral and somatic changes in both groups have a common etiology and that the anemia and jaundice seen in infants whose mothers are Rh negative are produced by the iso-agglutinins in the mother. The alternate theory would be to assume that the visceral and somatic changes as well as the anemia and jaundice seen in infants with erythroblastosis fetalis are dependent on iso-agglutinins developed in the mother during pregnancy and that these same changes can also be produced by an entirely different and unknown factor which is related to the diabetic syndrome.

There are other points which indicate a possible relationship between infants born to diabetic mothers and those with erythroblastosis fetalis. In both groups of infants congenital anomalies occur more frequently than normally seen,[7, 8, 21, 22] and toxemias of pregnancy have a higher incidence in their mothers.[8, 22, 23, 24, 25] Erythroblastosis fetalis has long been considered a familial disease and Levine's work[11, 17, 18] has put this on a sound theoretical basis. It is equally interesting to observe that repeated fetal and neonatal deaths are also seen in diabetic pregnancies. In fact, it has been shown that for fifteen or twenty years before diabetes can be diagnosed in the mother the fetal and neonatal mortality is appreciably increased and that the nearer the mother comes to the onset of her diabetes, the higher the mortality in her offspring becomes.[26] The risk to the fetus in the five years preceding the onset of diabetic symptoms is the same as that after diabetes is established and is equal to that seen in a group of fetuses with erythroblastosis fetalis born to mothers who are Rh negative.

The fact that the mother's blood is Rh negative is not an absolute answer to the question as to whether or not the infant will develop anemia or jaundice or both when normoblasts are present in large numbers in the blood. In Case 8 of Table IV the mother was Rh negative and the infant, Rh positive. The red blood cell count was 6.6 million per cubic millimeter on the day of death. It is particularly interesting in view of the absence of anemia and jaundice in this infant that the mother was found to have diabetes mellitus a few months after its birth. Diabetes in the mother does not exclude the development of anemia and jaundice in the infant. Case 1 of Table I illustrates this point. Since the infant in this case was the only one known to have anemia and jaundice among more than 100 whose mothers had diabetes mellitus, it is not improbable on the basis of a chance selection that the

mother was Rh negative and that iso-agglutinins were present. Unfortunately, Rh determinations were not made on the blood of either the mother or infant.

It is clear from the data on infants born to diabetic mothers that excessive extramedullary erythropoiesis can occur in the absence of anemia. This observation suggests that the erythropoiesis seen in the liver and other tissues of infants with erythroblastosis fetalis may not be dependent on the rapid hemolysis of red blood cells. It is interesting, in view of the aforementioned findings, to note that there was apparently some correlation among the amount of extramedullary erythropoiesis, the degree of cardiac hypertrophy, and the hyperplasia of the islet tissue of the pancreas in the infants with erythroblastosis fetalis.

The data on the post-mortem findings in these two groups of infants cannot be considered complete, particularly as regards the glands of internal secretion. Several infants born to diabetic mothers have been reported to have a marked eosinophilia of the pars anterior of the pituitary,[27-29] and others, a considerable hyperplasia of the female sex organs.[30, 31] Unusual eosinophilia of the anterior hypophysis was found in Case 8, Table IV. The study of the changes in the pituitary, adrenals, and gonads and their possible correlation with the other anatomical changes described here may be of importance in throwing more light on the pathogenesis of erythroblastosis fetalis.

CONCLUSIONS

1. The somatic and visceral changes seen in some infants born to diabetic mothers are similar to those seen in some infants with erythroblastosis fetalis. These changes are an increased normoblastemia, extensive extramedullary erythropoiesis, a hypertrophy of the heart, hyperplasia of the islands of Langerhans, adrenal enlargement, edema, macrosomia, and a tendency to hemorrhage in all the tissues of the body.

2. There are two striking differences between the two groups of infants. Infants with erythroblastosis fetalis frequently have anemia and jaundice and the Rh factor in the mother's blood is negative. Infants born to diabetic mothers rarely have anemia or jaundice and the distribution of the Rh factor in their mothers is similar to that in the population at large.

3. The relationship of the Rh factor in the mother to the similarities and differences in these two groups of infants is discussed.

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such manipulation incurs the risk of causing inadequacy in other essentials of the diet.

The small diagrams in the margin of Fig. 1 indicate the number of nutritional essentials and relative amounts of the daily quota supplied by each of the specified foodstuffs. It is important to note that some foods contribute to many different essentials, whereas others serve only specific purposes.

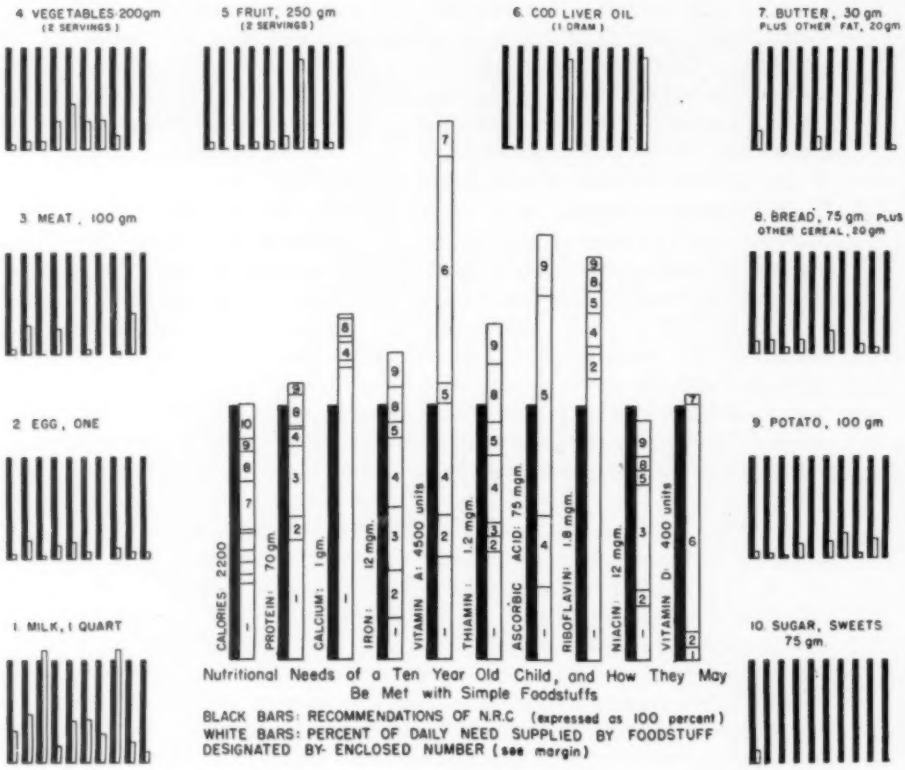
4 VEGETABLES 200gm (2 SERVINGS)
5 FRUIT, 250 gm (2 SERVINGS)
6. COD LIVER OIL (1 DRAM)
7. BUTTER, 30 gm PLUS OTHER FAT, 20gm
3. MEAT, 100 gm
8. BREAD, 75 gm PLUS OTHER CEREAL, 20 gm
2. EGG, ONE
9. POTATO, 100 gm
1. MILK, 1 QUART
10. SUGAR, SWEETS 75 gm
CALORIES 2200
PROTEIN: 70 gm.
CALCIUM: 1 gm.
IRON: 12 mgm.
VITAMIN A: 4500 units
THIAMIN: 1.2 mgm.
ASCORBIC ACID: 75 mgm.
RIBOFLAVIN: 1.8 mgm.
NIACIN: 12 mgm.
VITAMIN D: 400 units
Nutritional Needs of a Ten Year Old Child, and How They May Be Met with Simple Foodstuffs
BLACK BARS: RECOMMENDATIONS OF N.R.C. (expressed as 100 percent)
WHITE BARS: PERCENT OF DAILY NEED SUPPLIED BY FOODSTUFF DESIGNATED BY ENCLOSED NUMBER (see margin)

Fig. 1.

The amount, as well as the nature, of the prescribed foodstuffs must be emphasized. Fig. 2 shows the degree in which a varied diet, qualitatively very similar to the prescribed regimen, may fall short of meeting the desired levels of intake. Particularly to be noted is the ease of inducing deficits of protein, vitamin A, ascorbic acid, and vitamin D. Calories may similarly be deficient under a lax regimen, even though no protective food has been omitted from the dietary.

The heaviest contributor to all categories is milk. In the amount specified, namely, a quart a day, milk can in itself meet the whole re-

quirement for calcium and for riboflavin. Moreover, it contributes more heavily than any other single prescribed foodstuff to the provision of the day's quota of calories, protein, and thiamine. If the amount of milk

COMPARISON OF TWO SAMPLE DIETS FOR TEN YEAR OLD CHILD: PREVALENT VERSUS PRESCRIBED

Ingredients	daily intake prevalent	daily intake prescribed
milk	2 glasses	1 quart
egg	½ (ave.)	1
meat	75 gm.	100 gm.
vegetables (2)	½ cup+	1 cup
fruit	1 apple	1 apple 1 orange
cod liver oil	none	1 tsp.
butter	30 gm.	30 gm.
other fats	20 gm.	20 gm.
bread, enriched	6 slices	4 slices
oatmeal	large srv.	medium srv.
potato	2 servings	1 serving
sugar, sweets	75 gm.	75 gm.

Fig. 2.

intake were reduced much below the prescribed level, there would be likelihood of diet impoverishment in the specified categories. Full substitution for the omitted milk would not be easy, inasmuch as a variety of foodstuffs would be required to meet the incurred deficit in its entirety.

Vegetables and fruit serve as the preponderant source of ascorbic acid and also contribute heavily to the allowance of iron, vitamin A,

and thiamine. The adequacy of these foodstuffs varies in the respects enumerated, depending on the variety of vegetables or fruits chosen. Through emphasis on the use of raw products when digestibility permits, the choice of acid fruits as a safeguard against destruction of the vitamin C content, and the use of pigmented vegetables and fruits as assurance of high vitamin A content, the protective quality supplied through such foods will be enhanced. Improper preparation or cooking can result in the loss of protective substances. Much of the desired vitamin content may be destroyed and many of the minerals discarded with the peelings or they may be leached out with the water used in cooking. Potatoes, for example, in their raw state contain valuable amounts of many protective factors. When cooked in the skin and peeled just before serving their retain much of their value. On the other hand, when potatoes have been overcooked or exposed to oxidation through mashing or beating, and possibly further deteriorated through recooking, they may offer little other than starch toward nutritional advancement.

With reasonable care in the choice of the prescribed foodstuffs, there is little likelihood of deficiency of vitamin A even in the diet which does not include fish liver oil. The oil alone, however, will supply essentially the full requisite of that vitamin when used in the amount indicated.

Protein needs are met primarily through the use of milk, eggs, and meat. The prescribed amount of milk in itself will supply about one-half of the protein needs of the 10-year-old child. The remainder of the protein needs are obtainable principally from meat and eggs, supplemented by vegetable proteins. The meat is needed not only for its protein, but also for its iron and niacin content. On the basis of present knowledge, it seems improbable that niacin deficiency can be avoided when meat products are not included liberally in the diet. The enrichment of flour includes niacin, yet to derive the whole day's quota of niacin from enriched bread would require the ingestion of about twelve slices at each meal.

The provision of adequate vitamin D deserves attention. Even with a diet in which milk, eggs, and butter are plentiful with other ingredients supplied in a balanced form but with omission of fish liver oil, only a small fraction of the predicted need of vitamin D will be supplied. Of course, the child who regularly and predictably is exposed to direct sunlight in the midtemperate zone can be expected to produce his own vitamin D and in amount probably sufficient to meet his needs. On the other hand, the child who attends school or who, for other reason, is not exposed regularly to effective sunrays cannot be expected to get his vitamin D through solarization. Either his vitamin D must be supplied to him through his diet or else he will fail to maintain the level of supply the Council has recommended.

Milk, eggs, meat, vegetables, fruit, and fish liver oil often are termed "protective foods" because of their high content of the protective nutritional factors: protein, minerals, vitamins. Amounts of such foods adequate to meet fully the needs for protective substances will not in themselves insure adequate amounts of energy. Through reference to Fig. 1 it will be seen that only one-half of the caloric need has been supplied through the protective foods. The remainder of the energy is offered through foods which do not contribute much, if anything, to the essential quota of protective factors. This practice is justifiable. Whereas the energy need could instead be completed through further intake of protective foods, this would offer no recognized nutritional advantage and it would tend to make the diet bulky and expensive. Fats and carbohydrates serve as useful sources of energy and should be included in the prescribed regimen unless there is specific indication for their avoidance. When prohibited or curtailed for presumed therapeutic reasons, the responsible agent should prescribe amounts of other foods sufficient to meet the resultant calorie deficit. The child who receives a diet which qualitatively and quantitatively is complete has much less desire for sweets than does the child whose nutritional pattern is deficient. Rather than to prohibit the use of sugar or its products, one should specify the nature and the amounts of necessary foods the child should receive to provide for complete nutrition. I do not hold the belief that sugar need to be restricted to avoid tooth decay. The amount of sugar and its products included in a complete, well-balanced diet presumably can cause no harmful effects. The proposed diet is not high in its content of sugar, yet if that sugar were prohibited without offering adequate caloric substitute, the energy content of the diet would be lowered significantly. Table I

TABLE I

AMOUNTS OF VARIOUS FOODS OFFERING THE CALORIC EQUIVALENCE OF 75 GM. OF SUGAR

Sugar	5 tablespoonfuls
Jam, jelly	5 tablespoonfuls
Hershey chocolate	1¼ 5-cent bars
Coca-cola	3½ bottles
Chewing gum	38 sticks
Ice cream (vanilla)	1 large serving
Oatmeal	4 servings
Potatoes	2 servings
Apples	3 large
Bananas	3 small
Dates (dried)	12
Peanut butter	10 teaspoonfuls
Peanuts	5 dozen (50 Gm.)
Milk	15 ounces
Butter	40 Gm.

shows the manner in which 75 Gm. might be supplied daily either as such or as its products and also the amounts of some other foods or condiments which would be required to supply an equal amount of en-

ergy. Obviously some of the suggested substitutions are not designed for use; certain of them would not lessen sugar consumption, and others represent impracticable additions to the remainder of the prescribed diet. Table I serves to illustrate the difficulty in readily replacing one specified ingredient with another.

If the use of sugar and its products were prohibited, the child with boundless appetite might have little difficulty in completing his caloric needs through use of a reasonable substitute. Many other children would be less fortunate. If their caloric needs were not met fully, part of the ingested protein would be used for fuel rather than for tissue building. If the energy deficit were still greater, the child's own substance would be consumed to meet the need. Adequacy of protein and of calories are closely interrelated. Thus, it is important to make as ample provisions for caloric adequacy as for other factors in normal nutrition.

It is improbable that any child will receive a diet consistently as adequate as the Council's recommendations call for unless the intake of a basic menu is assured through suitable prescription and supervision. It is not enough for the physician or dentist to tell the patient that a child should have a "good, well-balanced diet." Neither is it enough to specify that the child shall have "lots of milk, meat, eggs, vegetables, and fruit." To talk in terms of needs for vitamins or minerals to the average parent will result only in confusion. To bolster the diet regimen with pharmaceutical products is inadequate and unsound. Every child deserves to have special attention directed toward his diet. Each physician and dentist should recognize the importance of proper diet guidance. However, those who offer diet advice should either familiarize themselves thoroughly with the quantitative and qualitative aspects of dietetics and nutrition or else employ diet regimens which have been prepared by persons skilled in those branches, with the age and peculiar needs of the child kept uppermost in mind in the prescription of the diet.

NOTE.—Values for food analyses have been taken from the manual by Bowes and Church. Two further references of practical value in the study of food composition and the prescribing of diets also are appended.

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PROMIN IN THE TREATMENT OF TUBERCULOUS MENINGITIS

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PROMIN, the sodium salt of p,p′-diaminodiphenylsulfone-N,N′,di-dextrose sulfonate, has been shown by some to have a beneficial effect on experimental tuberculosis in guinea pigs.[1-7] A retardation effect was noted whether the promin was nebulized,[10] fed,[11] or injected. One worker, however, found that it gave discrepant results;[6a] another, that it did not consistently produce complete resolution in the experimental disease.[6b]

Promin has been studied in other infections, such as gonorrhea,[10] poliomyelitis,[11] influenza.[11] It has been standardized in the human being by Toomey and Roach[12] and its safety demonstrated when injections were made intravenously. The blood soon returned to normal when the drug was discontinued.[13, 15] Following oral treatment[12-14] certain toxic effects, such as hemolytic anemia and agranulocytosis, have been noted.

Toomey and Takacs[14] found no urinary concretions in monkeys given six times the doses recommended for adults. Toomey and Roach[12] found fewer toxic reactions with promin than with sulfanilamide in the treatment of 150 patients with streptococcic infections.

Emmart and Smith[16] showed that tubercle bacilli grown in media containing promin lost their virulence even after transfer to control media.

When the drug was tried in human beings ill with pulmonary tuberculosis, the results were less striking.[17, 18] This was true likewise of six patients ill with tuberculous meningitis.[18] It should be stated in connection with tuberculosis that the patients who improved with promin therapy were of the type who tended to improve spontaneously and, therefore, the contribution of the drug to improvement could not be determined.[20]

The present paper is a report on eleven patients with tuberculous meningitis treated intravenously with promin in the Division of Contagious Diseases, City Hospital, Cleveland, between 1941 and 1943.

The ages of patients varied from 5 months to 29 years. Six were males and five were females; six were Negroes and five were white.

From the Division of Contagious Diseases, City Hospital, and the Department of Pediatrics, Western Reserve University.

The promin used in these experiments was supplied by Parke, Davis & Co., Detroit, Mich.

The duration of meningeal disease prior to admission as judged by meningeal or neurologic symptoms varied from four to fourteen days, the average duration being nine days.

All the patients died from two to ten days after admission to the hospital, the average length of life in the hospital being 6.5 days.

In this series, the average length of life after the onset of meningitis was 15.6 days. The longest any patient lived after the onset of symptoms was twenty-three days.

In four patients (Cases 4, 5, 9, and 10, Table I) spinal drainage was also employed and promin was given intravenously in hypotonic saline solution (0.45 per cent). The latter ran continuously, the drug being added in 5 Gm. doses to the infusion, usually three times in twenty-four hours. In the other patients the drug was given intramuscularly in 5 Gm. doses in 10 c.c. of normal or one-half normal saline, the usual dose being 5 Gm. three times a day. One patient (Case 6), however, received a total of 225 Gm. of promin in six days—almost 38 Gm. per day.

The total dose of drug given varied from 10 to 225 Gm. Of the patients treated for over two days and excluding the one receiving 225 Gm., the average total dose of promin was 53.5 Gm.

The findings in the spinal fluid of all patients were consistent with a diagnosis of tuberculous meningitis, that is, a positive Pandy test and presence of mononuclear cells, the total number of cells ranging from 40 to 600 per cubic millimeter. Acid-fast bacilli were found in the spinal fluid of three patients and the evidence obtained from post-mortem examinations in seven of the eleven patients confirmed the diagnosis of tuberculous meningitis. Of the other four patients, a 3-year-old white male (Case 3), in addition to the clinical picture and the findings in the spinal fluid, had a strongly positive tuberculin test; a 22-year-old Negro (Case 5) had a positive tuberculin reaction and enlarged mediastinal lymph nodes by x-ray; the mother of a 3-year-old white male (Case 7) had active tuberculosis; tubercle bacilli were demonstrated in the spinal fluid of a 4-year-old Negro girl (Case 10). The spinal fluid of these four patients was injected into guinea pigs, all of which died of tuberculosis.

One patient (Case 6) who received massive doses of promin died eight days after hospital admission. He had been given the drug for six days. He was a 29-year-old Negro in whom was found at autopsy miliary tuberculosis of the lungs, liver, spleen, kidneys, and pleura, in addition to the tuberculous meningitis.

Another patient (Case 4), an 11-month-old white male, lived nine days after admission and had been given promin for only three days, the total dose being 15 Gm. The total duration of illness in both patients (Cases 6 and 4) was twenty-three days. The latter patient also had active pulmonary and nodular tuberculosis.

TABLE I

CASE	AGE	RACE	SEX	DAYS ILL PRIOR TO ADMISSION	DAYS ILL AFTER ADMISSION	TOTAL DAYS ILL	DAYS OF PROMIN TREATMENT	TOTAL GM. PROMIN	SPINAL FLUID FINDINGS			AUTOPSY	OTHER EVIDENCE OF TUBERCULOSIS	MISCELLANEOUS
									CELL COUNT (MONONUCLEARS PER C.MM.)	PANDY TEST	OTHER			
1	5 mo.	N	F	8	6	14	4	55	235-310	4+	+ Tryptophane	+	Miliary, tuberculosis of liver, spleen, kidney; tuberculosis of right lung, tracheobronchial nodes	
2	29 yr.	N	M	7?	5	12	4	55	320-420 74-80%	4+	Sugar, 25 mg %	+	Pulmonary tuberculosis with cavity; tuberculoma of right lateral lobe of cerebellum	
3	3 yr.	W	M	12	7	19	2.5	35	72-40	4+	+ Tryptophane	0	Tuberculin 1:1000 4+ (O.T.)	
4	11 mo	W	M	14	9	23	3	15	70-90%	4+	Sugar, 26; Cl, 333; tbc. bacilli	+	Active primary tuberculosis of left upper lung and left bronchopulmonary nodes	Spinal drainage
5	22 yr.	N	M	4	7	11	1	15	250-350	4+	Sugar, 18; Cl, 351; proteins, 69	0	Tuberculin 1:100 4+ (O.T.); mediastinal nodes in chest (x-ray)	Spinal drainage
6	29 yr.	N	F	14?	8	22	6	225	195-427 82-91%	4+	Sugar, 23-18; Cl, 347-380; proteins, 179	+	Miliary tuberculosis of lung, liver, spleen, kidneys, peritoneum, pleura	
7	3 yr.	W	M	8	2	10	1.5	10	156 92%	3+		0		
8	14 mo.	W	F	7	2	9	2	20	164 89%	4+	Sugar, 17; Cl, 380; proteins, 231; negative tryptophane	+	Miliary tuberculosis of spleen, lung, liver, kidneys; tuberculosis of right upper lobe of lung	
9	26 yr.	N	F	11	8	19	6	75	600	4+	Negative tryptophane	+	Tuberculous lymphadenitis of left bronchopulmonary and mediastinal nodes	Spinal drainage
10	4 yr.	N	F	7	7	14	7	95	90 100%	4+	Cl, 320; proteins, 56; tbc. bacilli	0		Spinal drainage
11	3 yr.	W	M	8	10	18	4	45	250 100%	2+	Tbc. bacilli	+	Miliary tuberculosis of lung, liver, spleen; tuberculosis of right inferior bronchopulmonary nodes	
Average				9.1	6.46	15.6		53.5	(excluding cases 5, 6, 7, and 8)					

Similar findings were noted in other patients. One (Case 5) received promin on the last day of life. He lived seven days after admission and, in all, eleven days after the onset of the illness. Another patient (Case 2) was treated for four days with promin and received 55 Gm. of the drug, yet he lived only five days after admission, or a total of twelve days after the onset of the meningitis.

There was no significant difference in the course of the disease in the four patients treated by spinal drainage as compared with those not so treated.

No toxic effects from promin were noted when the drug was given intravenously.

COMMENT

Promin therapy was started from four to fourteen days after the onset of symptoms in eleven patients ill with tuberculous meningitis and was usually given late in the course of the disease. Whether earlier treatment would be of value is problematic in view of the severe disease usually present in other organs at autopsy.

CONCLUSION

Eleven patients ill with tuberculous meningitis were treated with promin without any beneficial result in either prolonging or maintaining life or altering the course of the disease.

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RESPIRATORY SHIFT IN EPIGASTRIC ABDOMINAL WALL—A PHYSICAL SIGN SEEN WITH COMPLETE UNILATERAL PARALYSIS OF THE DIAPHRAGM IN INFANTS AND CHILDREN

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THE recognition of diaphragmatic paralysis from physical examination alone is difficult. The sign herein described, although of limited applicability, is of clinical value in this respect and of some intrinsic interest as well.

Among the best known signs for detection of unilateral paralysis of the diaphragm are those of Duchenne,[1] Hoover,[2, 3] and of Kienböck.[4] Since reference is to be made to these later, a brief description of each is now given.

Duchenne's sign consists of a flattening of the epigastrium, or at least a lack of the usual bulging, on the affected side during inspiration and is explained on the basis of absence of the normal downward inspiratory pressure of the diaphragm on the homolateral epigastric viscera.

Hoover's sign stems from his conception of the normal inspiratory antagonism between the diaphragm, whose action tends to increase the longitudinal diameter of the thorax at the expense of the circumferential diameter, and the intercostals, which have the reverse action, tending to increase the circumferential diameter at the expense of the longitudinal. When the diaphragm is unopposed, as in intercostal paralysis, the lateral costal margin is brought nearer the midline during inspiration and the lower sternum is retracted toward the vertebral column, due to the normal pull of the contracting diaphragm on its anatomical attachments. This results in a diminution of the lower anteroposterior and lateral diameters of the thorax and a visible narrowing of the subcostal angle. With unopposed intercostal action, on the other hand, as when the diaphragm is paralyzed, the lateral costal border diverges much more from the midline during inspiration than on the normal side, with a resultant increase in the lower thoracic diameter and a visible relative widening of the subcostal angle. This widening of the subcostal angle is known as Hoover's sign; for practical purposes, in infants and children, it is seen in the form of a greater inspiratory rise of the costal margin on the affected than on the unaffected side, accompanied by greater expansion of the lower thoracic diameter on the affected side.

Kienböck's sign, or paradoxical movement of the diaphragm on fluoroscopy, is the hallmark of complete unilateral diaphragmatic paralysis,

From the Harriet Lane Home of the Johns Hopkins Hospital and Department of Pediatrics of the Johns Hopkins University School of Medicine.

although it is present at times in certain other conditions as well. On fluoroscopy the affected diaphragm is high. During a deep inspiration, while the unaffected diaphragm undergoes its normal downward motion, the paralyzed diaphragm moves paradoxically in an upward direction and the heart and mediastinal contents are drawn toward the sound side. During expiration, on the other hand, the sound diaphragm pursues its normal upward motion, while the paralyzed diaphragm moves downward and the heart shifts back toward the diseased side. The commonly accepted explanation for this seesaw movement is that the negative intrathoracic pressure produced on inspiration causes the upward motion of the flaccid paralyzed diaphragm, while the inspiratory shifting of the heart to the sound side is brought about through the negative pressure exerted by the unaffected diaphragm.

During the past five years I have had the opportunity of observing five patients of pediatric age with unilateral diaphragmatic paralysis who exhibited on inspection a sign consisting of a peculiar inspiratory diagonal component of movement in the epigastric abdominal wall. Summary of their clinical histories and description of the sign as exhibited by them follows:

CASE 1 (218398).—G. V. deM., white female, was born at the New York Hospital, New York City, Oct. 29, 1938, after a nineteen-hour labor. She weighed 2,630 Gm. The mother was a 32-year-old primipara with a borderline funnel pelvis. Presentation was by frank breech, converted to double footling breech. There was some difficulty in delivering the shoulders and the baby was in poor condition at birth, being resuscitated with difficulty. Her condition improved somewhat with the use of carbon dioxide-oxygen mixture, but cyanosis and gasping respirations continued and she was transferred to the pediatric service when 16 hours old. On examination she was weak and listless; the respirations were rapid and shallow and at times gasping, and there was moderate cyanosis which became worse on crying. The breath sounds were not well heard in general at the time, although later it became obvious that there was suppression of breath sounds, as well as dullness to percussion, over the lower part of the right chest. There was no evidence of brachial palsy. On fluoroscopy the right diaphragm was quite high and showed well-marked paradoxical movement with the accompanying to-and-fro movement of the heart and mediastinal contents. A diagnosis of "paralysis of the diaphragm in the newborn infant" was made.* Mild cyanosis persisted while the patient was in an oxygen box, and the child remained in poor condition, with X-ray evidence of superimposed atelectasis on the right, for about ten days. At the end of that time her general condition was improved and oxygen was withdrawn. Vomiting was a problem during the first month, and there was moderate anemia, for which several transfusions were given, but she gained well, and when discharged at 2 months of age, weighed 4,180 Gm. At the time of discharge the right diaphragm was still completely paralyzed, as evidenced by persistence of paradoxical movement under the fluroscope, while mild cyanosis and a moderate increase in the respiratory rate had continued. Follow-up was not possible, as the child was later taken to Italy.

Great interest in this case was attached to inspection of the abdomen and lower thorax. On repeated occasions it was noticed that with each inspiration the abdominal wall of the whole midepigastric regoin shifted markedly to the right and

*Since this condition is in the majority of instances associated with a brachial palsy and ultimate recovery of diaphragmatic function is the rule, the etiology is believed to consist of birth trauma affecting the phrenic nerve.[7-11]

to some extent also upward on the right, describing a diagonal or arciform type of movement (with the convexity of the arc downward), while with each expiration there was a shift back to the neutral position. In this movement the whole thickness of the abdominal wall seemed to partake, including the skin, so that a bit of adhesive tape placed over the midepigastrium would undergo the motion described. When the baby cried, with resultant deeper inspiration, the sign was even more marked. The appearance of diagonal movement was accentuated by the fact that the costal margin on the right rose strongly with inspiration (Hoover's sign), while on the left, if anything, there appeared to be descent. The umbilicus and the area immediately above it took part only minimally in this motion, while the xiphoid cartilage and the area of epigastric abdominal wall immediately below it did not participate.

CASE 2 (26471).—F. S., Negro male, 5 years of age, was admitted to the Sydenham Hospital for Communicable Diseases, Baltimore, Md., Sept. 30, 1939, with the diagnosis of poliomyelitis and was discharged as improved Nov. 9, 1939. He had had an acute illness of four days' duration, with paralyses appearing on the fourth day. There was extensive paralysis of the skeletal musculature, including weakness of the abdominal muscles. Moderate respiratory distress was present, without any obvious intercostal involvement, and fluoroscopy revealed complete paralysis of the left diaphragm with well-marked paradoxical movement, as well as to-and-fro movement of the heart and mediastinal contents. At the end of his first week in the hospital beginning diaphragmatic recovery was noted in that paradoxical movement of the diaphragm ceased while the dyspnea lessened, and by the time of discharge the left diaphragm had an excursion of almost normal extent.

During the period of complete diaphragmatic paralysis this child exhibited on inspection a phenomenon quite similar to that of the child discussed in Case 1, although referred to the opposite side and not so intense. With deep inspiration the abdominal wall of the midepigastric region showed a strong shift to the left and to some degree, also upward, while the costal margin on the left rose higher than on the right. The sign persisted as long as the paradoxical movement of the diaphragm was present and was no longer found when the latter was absent.

CASE 3 (A21991).—W. H., white male, 8 years of age, was admitted to the Harriet Lane Home of the Johns Hopkins Hospital Sept. 14, 1941, suffering from acute poliomyelitis. There was weakness of the arms and of the left side of the face. The intercostals on the right were considered to be paralyzed because of absence of lateral expansion of the chest on that side. The pharyngeal muscles and muscles of swallowing were also paralyzed, and the accumulation of secretions in the throat contributed to the dyspnea which was present. On brief inspection he displayed a phenomenon similar to that of the children described in Cases 1 and 2. With inspiration there was marked movement of the midepigastric abdominal wall to the left and upward and with expiration, return to the normal position. This was accompanied by a marked rise of the left costal margin during inspiration (Hoover's sign), confirming the impression of left diaphragmatic paralysis. His condition was such as to preclude fluoroscopy and he died shortly after admission. At autopsy there was considerable patchy atelectasis of both lungs, probably due, in part at least, to aspirated mucus and saliva.

CASE 4.—S. C. M., Negro female, was admitted to the Maryland State Tuberculosis Sanatorium, Henryton, Md., Aug. 12, 1940, at the age of 14½ years because of far-advanced right-sided pulmonary tuberculosis with cavitation. There was some involvement of the left upper lobe also. Pneumothorax on the right was resorted to on a number of occasions but was not entirely satisfactory. Thoracoscopic examination Dec. 17, 1940, showed the mediastinum to be fairly free, although there were some anterior and posterior adhesions of the lung to the pleura. On May 20, 1941, the right phrenic nerve was crushed. When seen Aug. 27, 1941, at the age of 15½

years, fluoroscopy revealed moderate paradoxical movement of the right diaphragm with accompanying to-and-fro movement of the heart and mediastinal contents. On inspection, if one watched the skin line on the epigastrium overlying the linea alba, the following was seen: With deep breathing the upper third of this line was displaced to the right, and somewhat upward at the height of inspiration, with return to the neutral position in expiration. (Hoover's sign was present but not at all marked.) Although this epigastric shift was not nearly so prominent a phenomenon as it was in the younger patients (Cases 1, 2, and 3), it was distinct enough to be agreed to by all observers.

CASE 5 (A29509).—I. L., white male, was admitted to the Harriet Lane Home of the Johns Hopkins Hospital March 6, 1943, at the age of 28 days, because of rapid labored respirations, immobility of the right arm, and frequent "spitting up" since birth. Delivery had been by breech extraction with forceps to the aftercoming head following a total labor of seven and one-half hours, the mother being a 23-year-old primipara. At the age of 27 days the baby's respirations became still more rapid and labored than before and cyanosis appeared, although there was no fever. When admitted, on the twenty-eighth day, he was found to be in a poor state of nutrition and desperately ill. The respirations were rapid and labored, cyanosis was present, there was thrush of the mouth, and a small firm mass, evidently a hematoma, was found in the body of the right sternomastoid. The right arm showed Erb's palsy. Flatness to percussion and complete suppression of breath sounds were found at the right base and lower right axilla, while at the corresponding areas on the left the note was hyperresonant and the breath sounds were of increased intensity. Over the left upper chest dullness and suppression of breath sounds were present. Fine râles were heard everywhere except in the left lower chest. X-rays showed extreme elevation of the right diaphragm, with no certain pneumonia, while on fluoroscopy paradoxical movement of the right diaphragm was clearly seen. The white blood cell count was 23,500, with polymorphonuclear leucocytosis. He was placed at once in an oxygen box and could not thereafter be withdrawn from it because of cyanosis. Sulfathiazole administration was started on admission, and, although discontinued after a few days because of temporary improvement, was soon resumed due to worsening of his general condition and his respiratory status. Small febrile rises appeared from time to time and finally there developed definite evidence of pneumonia, first in the right upper lobe, then in the left lung as well. On the sixteenth hospital day he died. Permission for autopsy was not granted.

Throughout his course he exhibited on inspection signs essentially similar to those of the patient reported in Case 1, although comparatively poorly marked and with relatively greater participation of the umbilicus and the area of abdominal wall immediately below it. Movements of chest and abdominal wall in this baby with deep inspiration are illustrated in Fig. 1.

In addition to the patients just reported who showed "epigastric shift," there were seen a number of patients with unilateral diaphragmatic paralysis who did not show this sign. These will be described and then an attempt will be made to explain the mechanism of the sign and the conditions under which it may or may not appear.

CASE 6 (26384).—C. C., white female, 11 years of age, was admitted to the Sydenham Hospital for Communicable Diseases, Baltimore, Md., Aug. 13, 1939, with probable acute poliomyelitis. There was paralysis of the pharyngeal muscles and the muscles of swallowing. The left diaphragm was almost completely paralyzed. On fluoroscopy it was high and moved little; there was no paradoxical movement. Inspection of the epigastric abdominal wall revealed no abnormal

movements. There was ultimate complete recovery of diaphragmatic function. This patient's condition is analogous to that of the patient reported in Case 2 after recovery of function had commenced.

CASE 7 (29081).—J. L. J., white male, 11 years of age, was admitted to the Sydenham Hospital Oct. 18, 1941, with the diagnosis of acute poliomyelitis and was discharged as improved Nov. 5, 1941. On admission he was dyspneic and had extensive skeletal muscular paralysis as well as weakness of the abdominal muscles and paralysis of the pharyngeal muscles and muscles of swallowing. Fluoros-

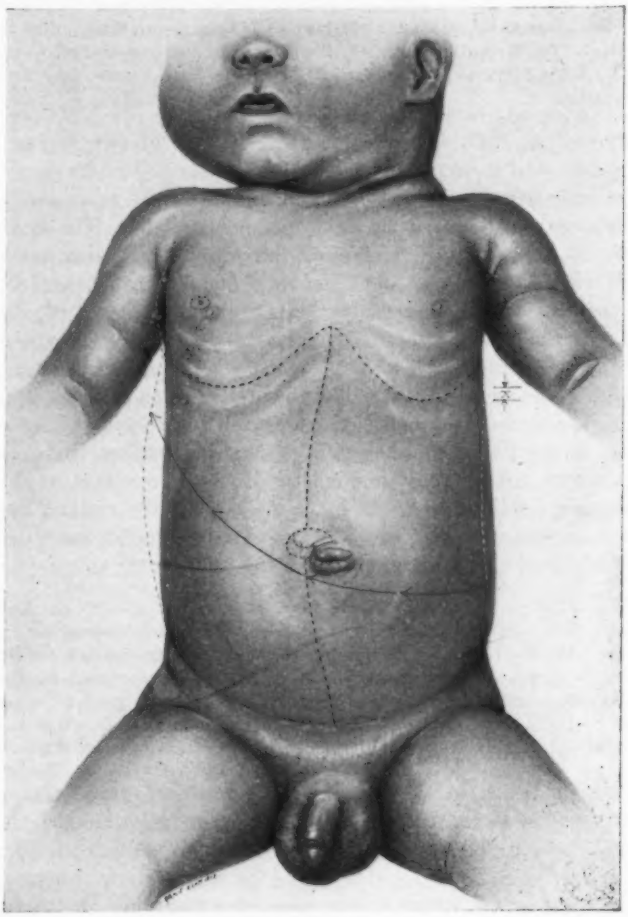

Fig. 1.—Paralysis of right diaphragm (Case 5), showing displacement of abdominal wall on deep inspiration. The dotted lines represent the extent of movement and the arrows its direction.

copy showed almost complete paralysis of the left diaphragm, which was high and moved down only slightly on inspiration. There was no paradoxical movement. On deep breathing Hoover's sign was marked, but shift of the midepigastric abdominal wall on inspiration was so little as to be questionable. A

tracheotomy was performed soon after admission and the child was then placed in the respirator, so that further observation was not feasible.

CASE 8.—P. E. S., Negro female, 8½ years of age, was seen at the Maryland State Tuberculosis Sanatorium, Henryton, Md., Aug. 27, 1941. She had extensive left-sided tuberculous consolidation, and resection of the left phrenic nerve had been carried out July 17, 1940. Her respirations were rapid and shallow. On fluoroscopy there was complete paralysis of the left diaphragm, but the paradoxical movement of the diaphragm, as well as the to-and-fro shift of the heart, was only slight. Whether this was due to the relative immobility of the intrathoracic structures because of the tuberculosis or to the shallowness of her respirations, or to both, is problematical. On inspection there was no abnormal movement of the epigastric abdominal wall. Attempts of the patient to take a deep breath were futile, although she tried.

From August, 1941, to January, 1942, a total of twenty-five adult patients, men and women, white and Negro, who had undergone therapeutic phrenic nerve operation at varying times in the past, were examined at the several tuberculosis sanatoria of Maryland. The age range was from 20 to 44 years. Several of the patients had also undergone contralateral thoracoplasty and a few had homolateral pleural fluid or pneumothorax. Eleven of these patients still had evidence of complete paralysis of the diaphragm in the form of paradoxical movement on fluoroscopy when they took a deep breath. Although sometimes fairly marked, this was never so marked as that reported in Cases 1, 2, and 5. Duchenne's sign and Hoover's sign were frequently seen in these eleven patients. In several, at the height of a deep inspiration, there was observed a slight, rather questionable shift in the upper part of the skin line overlying the linea alba. In no case was there the marked diagonal movement mentioned in Case 1. One fairly typical case deserves mention.

CASE 9.—M. N. G., white female, 29 years of age, was seen at the Eudowood Sanatorium, Towson, Md., Sept. 24, 1941. She had bilateral pulmonary tuberculosis, far advanced on the right. A right phrenicectomy had been carried out June 18, 1941. On fluoroscopy there was well-marked paradoxical movement of the right diaphragm with to-and-fro shift of the heart. A midepigastric gas bubble, probably duodenal, could be seen to be well displaced to the right on inspiration and back again with expiration. Inspection of the epigastrium revealed no abnormal movements.

In a consideration of the probable mechanism of production of the sign described in Cases 1 to 5 it would seem, on first thought, that the shift in the midepigastric abdominal wall with inspiration was simply a reflection on the abdominal wall of the paradoxical movement of the diaphragm going on within. For example, assuming the right diaphragm to be paralyzed, then with inspiration the left diaphragm would exert a downward and medialward pressure on the epigastric viscera that would not be counterbalanced by the right diaphragm, which, on the contrary, would move upward. This would allow for a displacement of the epigastric viscera to some extent to the right, and even upward to the right, with an accompanying similar movement of the

abdominal wall. The difficulty in this explanation lies in the fact that the epigastric viscera are not attached to the epigastric abdominal wall, and their gliding motion across its undersurface could hardly give rise to an accompanying motion in it. Nor is the fact that the falciform and round ligaments of the liver are attached to the umbilicus of any help, since the shift is primarily midepigastric rather than umbilical. This leaves us with the consideration that this shift in the epigastric abdominal wall is a corollary of Hoover's sign and is due to the pull of the heightened inspiratory ascent of the costal margin on the affected side, with associated widening of the subcostal angle and ballooning out of the costal margins themselves.

In order for the sign to appear, a number of conditions seem necessary. First, as will be obvious from the cases previously described, there must apparently be present complete paralysis of one side of the diaphragm as evidenced by paradoxical movement on fluoroscopy. The other side of the diaphragm, in view of the apparent mechanism of the sign, must probably be intact or very nearly so. Second, this sign, in its fully developed form, is seen only in infants and young children. Its failure to appear in adults is probably due to the relatively lesser increase in the ascent of the homolateral costal margin, which may be attributed to the lesser degree of mobility of the thorax itself in adults as compared with children. However, the abdominal muscles may also constitute a limiting factor in the ascent of the costal margin, and their relatively greater development in adults may be partly responsible for failure of the sign to appear. In comparison to the adult, the abdominal wall of the child has greater flexibility and mobility. In this connection, it may possibly be that in Case 2 the sign was more marked because of the abdominal muscle weakness than it would have been otherwise. Third, at least in children as compared with infants, it is necessary that a deep breath be taken. The failure of the sign to appear in Case 8 was probably due to the patient's inability to do this.

In a consideration of Case 3, the question comes up as to whether a coexisting contralateral intercostal paralysis would tend to enhance the sign; this seems a likely possibility. The presence of a coexisting homolateral intercostal paralysis, on the other hand, could be expected to suppress the appearance of the sign. Whether a unilateral intercostal paralysis could in itself give rise to the sign (on the opposite side) is problematical but seems quite unlikely.

It would appear possible that this sign might occur in patients with well-marked paradoxical movement of the diaphragm from some cause other than paralysis, such as eventration or hernia, but the literature has revealed no description of it in reviews of these conditions.

In a search of the literature there were found a number of clinical reports of patients with diaphragmatic paralysis whose physical findings included signs, seen on inspection, which corresponded to Duchenne's or to Hoover's sign. References to a few of these are given.[12-15]

Actual observation of epigastric shift must be accredited to Dyson,[16] who observed it in 1927 in a newborn infant with right-sided diaphragmatic paralysis (due to direct injury of the phrenic nerve by scissors used in severing the cord wrapped around the baby's neck during birth), although his implied explanation is probably incorrect. In detailing the physical signs, he made the following statement: "The right side (of the chest) ballooned out with each inspiration. The abdomen was rather jerky and it rolled from side to side during respiration. Inspiration seemed to push the abdominal contents from left to right, causing the abdomen to swell out synchronously with the unrestrained right costal wall above." Köttgen,[17] too, in 1938, detailing the findings in a newborn infant with right diaphragmatic paralysis, gave a description which indicated that he observed this sign: "Am Bauch sah man inspiratorisch eine Vorwölbung der linken Mittel- und Unterbauchgegend, die rechte Ober- und Mittelbauchgegend wurde dagegen eher zum Brustkorb hinaufgezogen."

SUMMARY

1. A physical sign seen in infants and young children with complete unilateral paralysis of the diaphragm is described. This sign consists of a shift in the epigastric abdominal wall, during deep inspiration, in a diagonal direction toward the side of the lesion and upward.

2. The sign is thought to depend on the pull exerted by the heightened inspiratory ascent of the homolateral costal margin which occurs when the diaphragm is paralyzed.

3. The conditions under which the sign occurs or fails to occur are described. Prominent among the former is the necessity that the diaphragmatic paralysis be complete enough to display paradoxical movement on fluoroscopy.

For permission to examine patients and to publish data about them, the author is indebted to the following: Dr. S. Z. Levine, New York Hospital, New York, N. Y.; Dr. H. L. Hodes, Sydenham Hospital for Communicable Diseases, Baltimore, Md.; Drs. V. F. Cullen, R. Hoffman, and S. S. Shaffer, Maryland State Tuberculosis Sanatoria; Dr. W. Newcomer, Eudowood Tuberculosis Sanatorium, Towson, Md.

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AUTONOMIC NERVOUS SYSTEM IMBALANCE OF THE WHOLE GASTROINTESTINAL TRACT IN THE NEWBORN INFANT

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TWO infants were seen with vomiting, bowel distention, and sufficient symptoms of partial bowel obstruction to be subjected to exploratory laparotomy. These symptoms were due to faulty innervation of the gastrointestinal tract. Both died from a terminal, adhesive peritonitis and malnutrition. The adhesive peritonitis has been explained as being due to chronic stasis, thinning of the bowel wall with leakage through the extremely thin bowel wall, and probable escape of organisms through the lymphatics. Search of the usual literature[1-3] fails to reveal mention of the clinical picture displayed by these infants. The second, more recent case was seen by five other pediatricians, not as consultants, but as interested colleagues who were trying to be helpful. None had observed a similar condition. Neither the post-mortem findings nor x-ray studies suggested a congenital megacolon, of which subject there is an adequate and rapidly growing literature. There is nothing constructive to offer in the way of treatment in this report, various parasympathetic drugs having been used without success. It would have been extremely helpful, however, from the standpoint of prognosis, had there been available a description of such a syndrome. Weeks of hopeful expectancy by the anxious parents could have been tempered by giving an unfavorable prognosis early in the course of the ailment.

CASE 1.—Baby B. S., 3½ weeks of age, was delivered at a hospital at full term. The mother was a primapara, primagravida. The delivery was normal. The baby appeared normal for two days. On the third day of life vomiting began and grew severe enough to warrant a barium gastrointestinal x-ray examination. This revealed marked delay in the emptying time of the stomach, barium still being present in the stomach after nine hours, and filling the small bowel to the colon after twenty-four hours. Quantities of gas were seen both in the small and large bowel, with evidence of distention. The baby was discharged on the tenth day of life, at the time of the discharge of the mother. Breast feeding was discontinued and a moderately thickened feeding of Farina, whole milk, and dextrimaltose prescribed. Atropine and phenobarbital were given twenty minutes before feeding. The baby had done quite well on this feeding previous to discharge, having regained its birth weight, and vomited very little after each feeding. This improvement did not continue. Vomiting recurred, the abdomen became more distended, and a diarrhea ensued with from eight to ten liquid, intensely foul stools with a putrefactive odor.

The baby was seen at home Dec. 12, 1937, when 19 days old. He was sent to Wesley Memorial Hospital the next day, Dec. 13, 1937. He was markedly dehydrated

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with a greatly distended abdomen. Outlines of loops of bowel could be seen across the abdomen. Veins over the abdominal wall were distended and prominent. There was no palpable pyloric tumor and no masses. Intestinal movements could be heard with the stethescope. Physical findings were otherwise negative.

Upon surgical consultation with Dr. Earl O. Latimer, an exploratory laparotomy was decided on, the opinion being that an atresia or partial bowel obstruction existed. At operation the small bowel was balloonlike in its distention. A segmented spasm occurred repeatedly during the exploration. The colon was also distended but to a lesser degree than the small bowel. The stimulation of handling the bowel caused the spasm to disappear. No obstruction was found. The appearance of the peritoneum was normal. Great difficulty was experienced in getting the intestines back into the abdomen for closure.

After surgery the baby was placed on feeding of partial mother's milk and a one part evaporated milk and water and dextrimaltose feeding on a four-hour schedule. Atropine was given twenty minutes before feeding because of the continuing regurgitation. Inability to take and hold down adequate feedings persisted. The abdomen grew steadily in size. The lose stools, while infrequent, continued and retained their putrefactive odor. Stasis in the colon was proved by rectal irrigations and the return of large quantities of stool. Insertion of a rectal tube helped the distention very little. Atropine was continued for two weeks. Its use seemed logical for the regurgitation and the segmented spasm of the bowel. No medication was given from then, Dec. 27, 1937, the fourteenth hospital day, to Jan. 13, 1938, the thirty-first hospital day. Prostigmine bromide by mouth, 2 mg. every eight hours, was given for three days without effect. On Jan. 14, the thirty-second hospital day, a pyelitis developed which responded to sulfanilamide therapy, and the urine was free from pus and was sterile in thirteen days. Transfusions were given. A barium enema x-ray study of the colon was done Jan. 26, 1938. It showed the colon to be considerably enlarged with irregularities in outline due to the occurrence of spasm in irregular segments of the colon as the material was injected. This was evidence that segmental spasm of the bowel still existed. There was a steady loss in strength and increase in the size of the abdomen, finally getting so large that it was about four times the size of the chest, with so little muscular an adipose tissue that the intestinal loops could almost be seen as through a membrane. A hernia of the abdominal wall occurred in the left abdominal wall below the costal margin and in the midaxillary line. Death occurred Feb. 16, 1938, two months and two days after entrance to the hospital, at the age of 2 months, 24 days.

Post-Mortem Findings.—The post-mortem findings are given in brief, as follows:

Anatomic Diagnosis:

1. Marked distention of the entire bowel, with necrosis of portions of the transverse and descending colon
2. Chronic adhesive peritonitis
3. Slight congestion of the kidneys
4. Slight distention of the right auricle
5. Lack of aeration of the lungs
6. Hernia of the left abdominal wall
7. Right rectus scar
8. Decubitus ulcers of the sacrum
9. Marked emaciation
10. Atrophy of the skin

Detailed Description of the Pertinent Findings: Abdominal wall was extremely thin. The transverse colon was adherent to the upper and left parietal wall over an area 4 by 6 cm. On the left parietal wall the descending colon was so adherent and necrotic that it could not be separated without tearing. The loops of the large

and small intestine were bound together and to the parietal wall by dense adhesions which could, however, be separated with some difficulty.

Intestines: There was extensive distention of all the intestines, especially of the large bowel, with advanced necrosis. Herniation of the descending colon through the left parietal wall was protected only by skin. There was no obstruction in the bowel.

Stomach: Small stomach; normal pylorus.

Liver: 138 Gm.; no gross pathology.

Spleen: 12 Gm.; no gross pathology.

Pancreas: 5 Gm.; no gross pathology.

Adrenals: Two together, 6 Gm.; pale in color.

Kidneys: Left, 13½ Gm.; right, 13 Gm.; injected area between the medullary and cortical.

Lungs: Both subcrepitant; left showed some hypostatic congestion posteriorly.

Heart: 22 Gm.; right auricle slightly distended; pericardial surfaces of the heart were slightly dull.

Brain: Head not posted.

Histologic Findings: Normal findings, except the lung tissue, which showed congestion and edema with small emphysematous areas between.

CASE 2.—Baby J. H., born April 17, 1943, was a large baby, with a birth weight 11 pounds, 1 ounce. The mother was a primipara primagravida. Difficult labor was terminated with low forceps. There were forceps bruises on the infant's face. Nothing unusual was noted until the third day of life, when a very extreme distention of the abdomen occurred. A flat plate of the abdomen without the ingestion of barium showed a large amount of gas in the small intestinal loops and colon. This distention responded and receded under colonic irrigations. The infant was discharged from the hospital on the tenth day. He was seen at home May 1, 1943, when 13 days old. Examination at this time revealed a large, apathetic baby with moderate dehydration. The abdomen was distended. Only from two to two and one-half ounces of food could be given without vomiting. Feedings were on a four-hour schedule, with an evaporated milk, water, and dextrimaltose mixture being given. The baby was having from four to five loose brown stools with a very offensive, putrefactive odor. There was a mild pharyngitis and a temperature of 101° F. Other findings were negative. The baby was placed on a three-hour schedule with a formula of one part evaporated milk to two parts water and Casec. There was no improvement, and he entered Wesley Memorial Hospital May 3, 1943, when 15 days old. The abdomen showed greater distention. Intestinal sounds were faint. Weight had dropped to 10 pounds. The baby was given normal saline subcutaneously and also protein milk by gavage.

Laboratory findings showed the following: red blood cell count was 4,740,000; hemoglobin, 16.5 Gm.; white blood cell count, 16,200. This count probably reflected a hemoconcentration, for after giving subcutaneous fluid three days later, the red blood cell count was 3,330,000; hemoglobin, 6.6 Gm.; white blood cell count, 16,500. Blood culture was negative.

X-ray examination: First a flat plate of abdomen was taken and then a barium enema given. The report was as follows: There was seen considerable distention of the ascending, transverse, and descending portions of the colon. There were a few loops of small bowel distended with gas. With a barium enema the opaque material flowed into the colon in a satisfactory manner. Some material flowed into the distal ileum. Following the evacuation, there was opaque material in the ileum and the course of the colon. There was no evidence of obstruction in the colon or ileum. A generalized enlargement of the colon was seen. A barium meal was given the next day. The esophagus was normal. The stomach was of small size. The pylorus opened after a long delay, approximately one hour. Two-hour observa-

tion revealed opaque material in the small bowel. Six-hour observation revealed small gastric residue. Opaque material could be expressed through the pylorus by manipulation. The colon was distended. This revealed a delay in the emptying time of the stomach and a distended colon.

Subcutaneous fluids were continued for three days as regurgitation and vomiting were persistent. There was a steady loss in weight. Six days after entrance, when the infant was 3 weeks of age, a surgical consultation was held with Dr. Earl O. Latimer. An exploratory operation was decided upon. At operation there was found moderate distention of all the intestinal loops, especially the colon. No obstruction was found. The pylorus was normal. A rather marked Jackson's membrane was severed, and the appendix was removed. This was done as there did seem to be a possibility that there was some narrowing at the iliocecal area because of the membrane.

There was no improvement in the regurgitation of food, and there was a steady drop in weight. Blood plasma and transfusions were given. Stools remained frequent, liquid, and foul smelling, of putrefactive character. Occasionally they would have a normal odor. Stool cultures were negative. Atropine was given before feedings for four days, from May 9 to May 13, the seventh to eleventh hospital day, without any effect on the regurgitation. After two weeks the stools became almost normal in consistency and number but still offensive in odor. On May 14, 1943, the twelfth hospital day, ½ c.c. of prostigmine, 1:4000 solution, was given every twelve hours, followed in one hour by an enema. On May 20, twentieth hospital day, six days after prostigmine was started, the abdomen appeared of a normal size for a baby of its age. As there was some generalized improvement and a 5-ounce weight gain for the previous week, the parents' desire to have the baby home was acceded to and the baby was discharged May 30, 1943, twenty-eight days after entrance. The food intake was from four to five ounces with occasional vomiting and regurgitation.

The baby was re-admitted June 4, 1943, four days after discharge. There had been no bowel movement for three days after discharge, the prostigmine having been discontinued at home. Enemas were given the third day, and large quantities of feces were expelled. Diarrhea began after this, and the stools became watery and still putrefactive in odor. He had, on admission, projectile vomiting and regurgitation, and again an inability to take more than from two to two and one-half ounces of food. Dehydration was again marked. Lactic acid milk feedings were given. Subcutaneous fluids and a transfusion were given. Prostigmine, ½ c.c. 1:4000, hypodermically every twelve hours was resumed on re-admission. A marked universal edema developed four days before death. This did improve after another transfusion. The abdomen became more and more distended. In spite of continued loose stools, quantities of small fecal masses could be palpated in the sigmoid through the abdominal wall. Death occurred June 27, 1943, at the age of 2 months, 9 days.

Post-Mortem Findings (Condensed to More Important Findings).—There was marked emaciation. The abdomen was greatly distended. There was a right rectus incision scar. The peritoneum was thickened and the intestinal coils were rather markedly adherent to each other. Marked diffuse adhesions extended from the bowel to the parietal peritoneum of the abdominal wall throughout. Fibrous adhesions likewise extended from the stomach and liver to the transverse colon. The appendix had been removed.

Description of the Organs and Systems: The entire bowel was increased in diameter. The small bowel wall was quite thin, and yellow food material could be seen through the wall. The wall of the large bowel was slightly thickened. The stomach was of normal size. The pylorus was normal.

Liver: 216 Gm.; normal in appearance.

Pancrease: Normal in size and appearance.

Genitourinary System: Kidneys together weighed 49 Gm.; normal in appearance, both externally and cut surface.

Adrenals: Together, 8 Gm.; normal in size and appearance, grossly and cut surface.

Cardiovascular System: Heart, 26 Gm.; normal in size and appearance; valves and structures normal.

Spleen: 15½ Gm.; firm in consistency and dark reddish brown in color.

Respiratory System: Lungs together, 68 Gm.; pinkish in color; lower right lobe congested posteriorly; no consolidation.

Brain: Is normal in appearance, grossly and in gross sections.

Microscopic Sections:

Spleen: Moderate congestion and slight thickening of the capsule.

Kidneys: Convuluted tubules of the kidney showed moderate degeneration.

Adrenals: Medullary portions were very much congested and hemorrhagic; cortical portion was quite edematous.

Liver: Fatty and parenchymatous; degeneration was very marked.

Lungs: Large proportion of the lung tissue was collapsed; These areas alternated with areas of emphysema; blood vessels were congested; bronchi were clear.

DISCUSSION

Both of these infants were subjected to laparotomy, which may be criticized. In defense of this, we may refer to the history of a baby born at Wesley Memorial Hospital about a year ago. This infant had vomiting and regurgitation from the third day of life with abdominal distention. On the thirteenth day of life it was recommended that a laparotomy be done. The surgeon did not wish to do so because a barium gastrointestinal examination showed no evidence of obstruction and barium was passed in the stool eighteen hours after its ingestion by mouth. When 5 weeks old, the infant's condition became so grave that exploratory laparotomy was done, and at operation a deficient mesentery of the ileum was found with a torsion of it about a congenital band. Surgery was lifesaving.

Atropine, a parasympathetic nervous system inhibitor, was given for a short time to both patients. It was given in the first case, in spite of the distended bowel, because of the segmental spasm and regurgitation. In neither patient did atropine do any good. The regurgitation was probably due to the stasis in the whole gastrointestinal tract, with backing up of gas and intestinal contents all the way to the stomach, as well as to atony of the stomach, rather than to any pylorospasm.

In the first patient there was no examination of the brain, so that cerebral hemorrhage was not excluded, although there were no symptoms of this at birth or later. In the second patient there was no gross evidence or gross section evidence of cerebral hemorrhage, although the severe labor and size of the infant could well have caused one. Watts and Fulton[4] state that damage of the brain in certain areas of the cortex may cause intestinal stasis. No gross evidence of such a lesion existed. One might conceive that there was damage in the hypothalamus in the visceral motor nucleus of the vagus. It would be hard to conceive that any specialized area alone would be involved; that is, the gastrointestinal

tract. If this area was involved, there would also have been marked cardiac symptoms. There were no cardiac symptoms.

Both infants had a kind of overflow diarrhea with putrefactive stools. Mellanby (1926)[5] found that as a result of vagus stimulation, the trypsin and amylase secretion is increased. It is conceivable that because of faulty vagal or parasympathetic stimulation, trypsin was not secreted in adequate amounts and that faulty digestion of protein caused the putrefactive decomposition and persistent foul odor.

CONCLUSIONS

1. A generalized atony of the whole gastrointestinal tract may occur in the newborn infant. There may be atony alone or with localized spasmodic contractures of the intestine. The cause of this is probably an imbalance of the autonomic nervous innervation. The cause of this imbalance, whether overstimulation of the sympathetic or deficiency of stimulation of the parasympathetic, whether anatomic or physiologic in the complex secretory control, is mere speculation.

2. No treatment tried, parasympathetic-inhibitor drug (atropine) or parasympathetic-stimulator drug (prostigmine), was of any lasting benefit.

3. The condition has to be differentiated from partial obstruction and from congenital megacolon, both of which conditions may be treated successfully with a fair prognosis.

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DEVELOPMENT OF ANTIBODY FOLLOWING VACCINATION OF INFANTS AND CHILDREN AGAINST PNEUMOCOCCI

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DURING the past five years 65 per cent of the cases of pneumococcus pneumonia treated at the Harriet Lane Home have been caused by five types of organisms, types I, VI, XIV, XV, and XIX.[1] In addition, these same organisms have been the cause of very many upper respiratory infections and complications, such as otitis media, which follow them. Pneumococcus infections among infants and children respond so readily to treatment with sulfonamides that it does not seem advisable to attempt mass immunization of children against these organisms. However, the spread of pneumococcus infections among infants on hospital wards[1] and in orphanages may become such a serious problem that immunization directed against the common disease-producing types of pneumococci might on occasion be a useful procedure in such institutions. In order to be of value immunization must be simple and harmless. The immunity induced must rise rapidly to effective levels and must remain elevated for at least several months.

The available information concerning the antibody response of infants and children to vaccination with pneumococci or their products is limited. Felton[2] has included a few infants in his experiments in the use of pneumococcus capsular polysaccharide as the antigenic agent and Davies,[3] using a similar preparation, has studied antibody response in a group of sixteen infants and children. Gundel and Schäfer[4] in the course of a series of studies on immunity to pneumococcus in infants and children, vaccinated a few infants with a whole cell, heat-killed vaccine. All the experiments cited gave similar results and appeared to indicate that older children respond to the whole pneumococcus or to its capsular polysaccharide by the production of antibodies in the same manner as do adults. However, this capacity is not possessed by young infants but is acquired only toward the end of the second year of life.

We have studied the production of pneumococcus mouse-protective antibodies in the serum of a number of infants and children following vaccination with heat-killed type I and type VI pneumococci. Most of the subjects were given the vaccine by intradermal inoculation. In a small group type I vaccine was administered by inhalation of a fine mist sprayed from a nebulizer.

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This study was supported by a grant from the John and Mary R. Markle Foundation.

The patients included in the study were children admitted to the Harriet Lane Home or to Sydenham Hospital. The group was made up, in part, of children who had recently recovered from an acute infection and, in part, of those admitted to the hospital for study of some neurologic or metabolic disorder. We attempted to avoid choosing children who had had recent pneumococcus infections, but in two instances children were vaccinated who were well along in convalescence from a pneumococcus infection caused by an unrelated type. The ages of the children in the study varied from 2 weeks to 13 years.

METHODS

Preparation of Vaccine.—

Type I: Approximately 15 ml. of a twenty-four-hour blood broth (pH, 7.8) culture of a virulent pneumococcus type I were seeded into approximately 300 ml. of 5 per cent rabbit plasma infusion broth (pH, 7.8) and allowed to grow at 37.5° C. for eight hours. At this time a portion of the broth culture was removed for dilution plate counts and the remainder was heat killed by exposure for thirty-five minutes in a water bath previously adjusted to 60° C. After rapid cooling the vaccine was stored overnight at icebox temperature. The following morning the killed culture was centrifuged, the supernatant discarded, and the organisms resuspended in approximately one-tenth the original volume of infusion broth (pH, 7.8). The vaccine was cultured aerobically and anaerobically for forty-eight hours before use and was ordinarily not used more than forty-eight hours after this. Occasionally, because of contamination of a fresh lot, vaccine was used for as long as ten days. After this period of time the organisms still showed good capsular swelling in homologous serum and retained their gram-positive characteristics. Before use, the volume of the vaccine was so adjusted that 1 c.c. represented approximately 1,000 million killed organisms.

Type VI: The procedure was identical with that for type I, but the organism employed was much less virulent for mice than was the type I. The type VI vaccine also contained approximately 1,000 million heat-killed organisms per milliliter.

Vaccination by Intradermal Inoculation.—Blood was drawn from each child before vaccination. The vaccine was given intradermally in the forearm on two occasions a week apart. Blood was again drawn for mouse protection test a week after the second inoculation of vaccine. In most cases the amount of vaccine given was 0.15 ml. at each injection, but occasionally the first dose was 0.1 ml. The total dosage represented approximately 300 million killed organisms, except in the case of two children, Ri. P. and Ra. P. (Table I), who received 1,000 million organisms in a single dose.

Vaccination by Nasal Spray.—Seven children received type I vaccine sprayed as a fine mist from a nebulizer applied to the nasal orifice. Amounts of vaccine varying from 0.5 to 3.0 ml. were administered at

each spraying. This procedure was carried out once or twice weekly for a total of from three to seven inhalations. The total amount of vaccine sprayed into the nose of each child varied from 2,000 million to 20,000 million organisms (Table III), but it is impossible to estimate the effective dose. As in the case of intradermal vaccination, bleeding was done before spraying was begun and at varying intervals during and following the course of vaccination.

Reactions: No reaction of any kind was observed among the children vaccinated by nasal spray. None of the children inoculated intradermally exhibited any rise of temperature or a systemic reaction, but nearly all of them showed a local reaction at the site of inoculation which resembled a moderately positive Schick test. In each case there was erythema and induration of varying extent which persisted for about forty-eight hours after vaccination, and a small central papule at the site of injection remained for three or four days. The center of this papule occasionally became necrotic and crusted. A small area of pigmentation was still visible at the end of several weeks. In no instance did the local reaction cause great discomfort, and none was extensive enough to cause alarm.

Mouse Protection Tests.—

Type I: White Swiss mice weighing from 18 to 22 Gm. were used. The pneumococcus type I was the same organism as that used to prepare the vaccine and was of such virulence that 0.25 ml. of a 10^{-7} dilution of a twenty-four-hour culture was regularly fatal for mice. Three mice were used for each culture dilution, the serum dilution being constant at 1:2. Rarely, when the amount of serum available was small, the test serum was diluted 1:10. Each mouse received 0.25 ml. of the test serum intra-abdominally, followed immediately by the same volume of culture in the dilution being tested. Normal rabbit serum was used as control. The mice were observed for seventy-two hours; mice remaining alive and well at the end of that period were considered survivors.

Type VI: The pneumococcus type VI was much less virulent for mice. A sixteen-hour culture, 0.25 ml. of a 10^{-5} dilution, killed control mice with regularity, although the end point was often not sharp. In an attempt to compensate for the low virulence of the organism, mice about 3 weeks old and weighing from 7 to 12 Gm. were used, and the test sera were diluted 1:10 in some of the tests. With these exceptions the tests were carried out as for type I.

In calculating the mouse-protective titer of the sera, no difficulty was encountered in determining the end point of those tests carried out against the type I pneumococcus. In tests done with the type VI organisms, however, much more scattered results were frequently obtained. In order to clarify the interpretation of the data, the 50 per cent mortality end point formula of Reed and Muench[5] was applied.

The logarithmic difference between the number of 50 per cent mortality doses protected against by the control serum as compared with the test serum has been expressed (Table I) as the next lowest round number. For example, in Table I the serum-protective power of patient Ri. P. after vaccination is recorded as 300,000 50 per cent mortality doses. This means that 300,000 times the number of organisms were required to kill 50 per cent of the mice treated with the patient's serum as were necessary to kill 50 per cent of those treated with the control serum. That is, the patient's serum exhibited 300,000 times the mouse protective capacity shown by the control serum.

RESULTS

Type I.—The titers of mouse-protective antibody against type I pneumococcus following intradermal vaccination were determined one week after the completion of vaccination and are recorded in Table I. The occurrence of significant amounts of antibody in the serum was uncommon before vaccination. Such titers were demonstrated in only three sera obtained from children over 2 years of age. Within one week following vaccination, however, there was a sharp rise in titer among the children over 2 years of age. Among this group the sera of seven of the fifteen children protected mice against 100,000 or more 50 per cent mortality doses of type I pneumococci. Seven others were effective against from 10,000 to 50,000 50 per cent mortality doses, while the one remaining serum afforded protection against 5,000 doses.

As recorded in Table I, none of the sixteen children under 2 years of age showed a significant titer of mouse-protective antibody before vaccination, and fourteen of these children failed to develop a significant increase in titer after vaccination. The serum of one of the two remaining children gave protection against 10,000, the other against 150,000 50 per cent mortality doses.

The sera of four of the children over 2 years of age were also tested a number of months after vaccination. In each case the mouse-protective titer was still at a high level. The sera of one child, C. L., protected against 50,000 50 per cent mortality doses one week after vaccination and showed a titer of 100,000 two months later. The titer of the serum of C. K. was 20,000 one week after vaccination and 50,000 after an interval of five months, while the serum of D. M. rose from 15,000 one week after vaccination to 100,000 three months later. The fourth child, S. T., exhibited a decline in titer from 50,000 one week after vaccination to 5,000 when the serum was tested after a period of four months. This latter figure, however, represents a significant increase over his prevaccination serum protective titer which was zero.

The three children of the older group whose sera possessed a high titer of mouse-protective antibody to type I pneumococcus before vaccination showed quite different reactions from the rest of the group. The serum of one of these children showed only a twofold increase in

antibody, and the antibody levels in the other two were decreased. A month following vaccination, these children were bled again and mouse-protective antibody had returned to its original prevaccination level or to slightly above it. It is probable that these variations are within the limits of error of the method of measuring antibody and are themselves of no significance except to suggest that with antibody levels in this range existing before vaccination the antigenic stimulus administered had little effect.

TABLE I

DEVELOPMENT OF SERUM MOUSE-PROTECTIVE ANTIBODY FOLLOWING INTRADERMAL VACCINATION WITH HEAT-KILLED TYPE I PNEUMOCOCCI

NAME	AGE	PROTECTIVE TITER OF SERUM (50% MORTALITY DOSES)	
		BEFORE VACCINATION	ONE WEEK AFTER VACCINATION
		Children Over 2 Years of Age	
Ri. P.*	4 yr.	<10	300,000
Ra. P.*	8 yr.	0	150,000
D. L.	7 yr.	0	150,000
M. L.	8 yr.	0	150,000
D. R.	7 yr.	10	150,000
M. K.	5 yr.	0	100,000
M. Mc.	8 yr.	0	50,000
S. T.	4 yr.	0	50,000
C. L.	6 yr.	<10	50,000
C. K.	7 yr.	100	20,000
D. M.	5 yr.	0	15,000
V. H.	7 yr.	<10	5,000
K. B.	3 yr.	50,000	100,000
B. B.	9 yr.	50,000	20,000
S. Ta.	7 yr.	100,000	15,000
		Children Under 2 Years of Age	
D. R.	4 mo.	0	0
M. A.	9 mo.	0	0
R. M.	12 mo.	0	0
W. Wa.	10 mo.	<10	0
R. B.	4 mo.	<10	0
J. A.	12 mo.	<10	0
G. P.	8 mo.	0	<10
J. K.	3 mo.	0	<10
F. S.	15 mo.	<10	<10
S. Sch.	14 mo.	<10	<10
D. B.	1 mo.	<10	<10
P. K.	18 mo.	0	10
V. C.	15 mo.	<10	50
W. W.	18 mo.	0	50
J. B.	18 mo.	<10	10,000
W. Mj.	21 mo.	<10	150,000

*These two children each received approximately 1,000 million killed pneumococci given in a single inoculation. All others received two doses, given a week apart, totaling 300 million killed organisms.

Type VI.—The results of the study on mouse-protective antibody in infants and children before and after vaccination with type VI pneumococci were quite inconclusive. It is apparent that the type VI pneumococcus vaccine was less regular in its effect than was that made with the type I organisms. The results obtained with the type VI vaccine are shown in Table II. Of the fifteen children over 2 years of

age, nine possessed sera which protected against 1,000 or more 50 per cent mortality doses of type VI pneumococci before vaccination. The sera of two of the twelve infants studied showed protective power in a similar range before vaccination. Only four of the fifteen individuals in the group over 2 years of age were vaccinated. Of these only one showed a significant increase in serum antibody—from a titer of 500 to 4,000 50 per cent mortality doses. Ten of the twelve infants under 2 years of age were vaccinated, but a significant rise of mouse-protective antibody titer following vaccination was demonstrated in only two. In one instance (S. B.) serum drawn after vaccination failed to protect mice against 100 50 per cent mortality doses, while serum drawn before vaccination protected against 3,000 such doses.

TABLE II

DEVELOPMENT OF SERUM MOUSE-PROTECTIVE ANTIBODY FOLLOWING VACCINATION WITH HEAT-KILLED TYPE VI PNEUMOCOCCI

NAME	AGE	DOSE OF VACCINE* (KILLED ORGANISMS)	PROTECTIVE TITER OF SERUM (50% MORTALITY DOSES)	
			BEFORE VACCINATION	ONE WEEK AFTER VACCINATION
Children Over 2 Years of Age				
G. S.	8 yr.	Not vaccinated	300	--
B. W.	13 yr.	Not vaccinated	300	--
J. M.	7 yr.	Not vaccinated	1,000	--
P. B.	9 yr.	Not vaccinated	1,000	--
W. Mc.	12 yr.	Not vaccinated	3,000	--
J. P.	13 yr.	Not vaccinated	3,000	--
P. W.	3 yr.	Not vaccinated	3,000	--
L. M.	6 yr.	Not vaccinated	10,000	--
Mu. W.	7 yr.	Not vaccinated	15,000	--
C. B.	10 yr.	Not vaccinated	30,000	--
A. N.	13 yr.	Not vaccinated	500,000	--
W. S.	5 yr.	300 million	10	10
E. J.	13 yr.	300 million	10	100
J. H.	2 yr.	300 million	10	100
M. G.	7 yr.	300 million	500	4,000
Children Under 2 Years of Age				
B. C.	3 mo.	300 million	0	0
C. R.	5 mo.	300 million	0	0
A. R.	8 mo.	300 million	0	0
M. S.	2 mo.	300 million	10	0
I. D.	7 mo.	300 million	0	10
B. L.	4 mo.	300 million	0	10
H. S.	12 mo.	300 million	100	10
S. B.	10 mo.	300 million	3,000	100
G. S.	4 mo.	300 million	10	500
C. C.	6 mo.	300 million	0	1,500
B. H.	4 mo.	Not vaccinated	100	--
F. S.	1 mo.	Not vaccinated	1,000	--

*Each child vaccinated received two intradermal inoculations, one week apart, totaling approximately 300 million heat-killed pneumococci.

Vaccination by Nasal Spray.—Seven children, all over 2 years of age, received the type I vaccine intranasally as a fine spray from a nebulizer (Table III). Significant titers of mouse-protective antibody developed

TABLE III

DEVELOPMENT OF SERUM MOUSE-PROTECTIVE ANTIBODY FOLLOWING INHALATION OF SPRAY OF HEAT-KILLED TYPE I PNEUMOCOCCI

NAME	AGE	NUMBER OF SPRAYINGS	APPROXIMATE TOTAL ORGANISMS SPRAYED (BILLIONS)	PROTECTIVE TITER OF SERUM (50% MORTALITY DOSES)	
				TITER BEFORE INHALATION OF VACCINE	MAXIMUM TITER RECORDED FOLLOWING INHALATION OF VACCINE
H. P.	31 mo.	4	2	<10	0
P. W.	30 mo.	4	2	<10	10
R. D.	8 yr.	3	4	<10	0
J. M.	5 yr.	4	2	<10	50
R. B.	4 yr.	7	6	0	2,000*
J. S.	8 yr.	6	4	0	10,000*
E. L.	12 yr.	7	20	0	30,000†

*Nine weeks after completion of spraying.
†Eighteen weeks after completion of spraying.

in only three of the children in this group. This is in contrast to the effectiveness of the intradermal inoculation of the same vaccine in children over 2 years of age.

DISCUSSION

The results following intradermal vaccination with whole cell, heat-killed vaccine prepared from pneumococcus type I agree with those of the investigators previously cited with regard to the failure to demonstrate an appreciable antibody response in young infants. It seems quite clear that the antigenic stimulus which was adequate for the production of serum antibody in children over 2 years of age was generally ineffective when administered to infants under this age.

However, among children over 2 years of age, the intradermal vaccination with the type I pneumococcus is regularly followed within a week by a great rise in the mouse-protective titer of the serum. This increase in titer appears to remain at a significantly high level for at least a number of months and appears to be of nearly the same order of magnitude as that which is found following pneumococcus pneumonia. Finland and associates,[6] in a study of antibody response after type I pneumococcus pneumonia treated with sulfonamides, have studied the mouse-protective antibody level in fifty-six adult patients. Of these fifty-six patients, the sera of two (3 per cent) protected against 0 or 10 minimal lethal doses of type I pneumococci; six (11 per cent) had titers of 100 or 1,000 minimal lethal doses. The sera of nineteen (35 per cent) protected against 10,000 or 100,000 minimal lethal doses and twenty-nine (51 per cent), against a million or more minimal lethal doses. In our group of twelve children over 2 years of age whose prevaccination antibody titer was 100 or lower, six (50 per cent) protected against 100,000 or more 50 per cent mortality doses after vaccination and five (42 per cent) developed titers of 10,000 or more, while

the remaining child developed a titer above 1,000. In comparing the two groups it is apparent that approximately one-third of the adult patients recovering from type I pneumococcus pneumonia developed mouse-protective antibody titers which were of the same order of magnitude as those induced in the children by vaccination, while the titers of one-half of the convalescent adults reached somewhat higher levels than those attained by the children. It is not clear whether or not the presence in the serum of vaccinated infants of mouse-protective antibody in amounts comparable to those of patients convalescent from pneumonia is in itself a guarantee of immunity, either complete or partial. However, it has been demonstrated that such levels of antibody may be induced against type I pneumococci in children over 2 years of age with some regularity by the intradermal inoculation of an amount of antigen which does not cause systemic reactions.

The administration of type I pneumococcus vaccine by intranasal spray apparently results in some instances in the development of mouse-protective antibody of significant titer. However, this method is not reliable and in our experience failed more often than it succeeded. In addition, it was very cumbersome and time-consuming and required a very much larger amount of antigen. A considerable portion of the vaccine administered in the spray collects in the nasopharynx and is swallowed. It is possible that the number of bacteria reaching the gastrointestinal tract is large enough to cause a rise in antibody titer, since Ross[7] has shown that immunity may be induced in rats by feeding 5 ml. of a culture of pneumococci (probably 500 million organisms) by stomach tube. It is impossible to determine what role was played by absorption of antigen through the mucosa of the nose and throat.

In the group of children over 2 years of age whose sera were tested for antibody against type VI pneumococcus, more than one-half showed protective titers of 1,000 50 per cent mortality doses before vaccination. This is in striking contrast with the lack of prevaccination antibody against type I pneumococci in the same age group. Only three of the twenty-two children (14 per cent) over 2 years of age whose sera were tested before vaccination showed a titer higher than 100 against the type I organism. The significance of this finding is not clear, but it is noteworthy that in our experience among children over 2 years of age 41 per cent of the cases of pneumonia are caused by type I pneumococci and only 6 per cent by type VI. It is conceivable that the lower incidence of type VI pneumonia among children over 2 years of age is dependent, in part, upon the relatively common presence of specific antibody.

There is insufficient data to judge the efficacy of the type VI vaccine employed. Only four children over 2 years of age were vaccinated, and of these only one developed a high titer of antibody. Only two of the twelve infants vaccinated showed a definite response, but this finding is in keeping with that observed with the type I vaccine.

CONCLUSIONS

1. Among children over 2 years of age, intradermal inoculation of a dose of heat-killed type I pneumococci which did not cause systemic reactions or serious local reactions was followed in nearly every instance by an abrupt rise in serum mouse-protective antibody titer. The level of antibody attained appears to be of the same order of magnitude as has been reported in adults following type I pneumococcus pneumonia treated with sulfonamides.

2. The rise in antibody titer following vaccination persisted for at least several months.

3. With few exceptions, no rise in antibody titer following intradermal vaccination with type I pneumococci was demonstrated among infants under 2 years of age.

4. Inhalation by children over 2 years of age of a spray of killed type I pneumococci was followed in a few instances by a significant rise in mouse-protective antibody titer. However, this method of vaccination was unreliable and cumbersome.

5. Intradermal vaccination with type VI pneumococcus vaccine yielded equivocal results.

6. Among children over 2 years of age, a high prevaccination titer of mouse-protective antibody against type VI pneumococcus was found much more often than against type I pneumococci.

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GONORRHEAL PERITONITIS IN CHILDREN

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GONORRHEAL disease in female children presents several features which differ decidedly from manifestations usually seen in adults. The disease usually takes the form of a vulvovaginitis and seldom involves the upper genital tract. Before puberty the vaginal epithelium with its deep rugae and crypts is naturally succulent and susceptible to invasion by the gonococci, but in the adult female the mucous membrane of the vagina is cornified and very resistant. Conversely, in the child the cervix apparently offers a successful barrier to the ascent of the etiological organism, since its glands are not nearly so well developed and differentiated as in the adult cervix and affords little or no channels for extension of infection upward toward the pelvic structures. In the adult the cervix is practically always involved at the onset, and from this organ the disease process extends over the mucous membrane of the uterus to the tubes, ovaries, and peritoneum. Thus, clinically, primary vaginitis in the immature is the common manifestation of gonorrheal infection. Cervicitis, salpingitis, oophoritis, and peritonitis are frequent pathologic findings in the adult, but in the child these infections are considered by most authors to occur exceedingly rarely.[2, 3, 7] A review of the literature reveals a paucity of statistics and reports on this complication of juvenile gonorrheal vaginitis so that a summary of the condition with a brief account of two typical cases may be of value.

Gonorrheal pelvic inflammatory disease in children is practically always preceded by, or is a complication of, a gonorrheal vulvovaginitis. A history of a vaginal discharge, past or present, is usually readily obtainable. There is most frequently a sudden, acute onset of generalized abdominal pain, often accompanied by a chill, nausea, and vomiting. The temperature rises rapidly, often to 103 or 104° F. in the first twelve hours. There is no definite localization of pain, although an older child may be able to appreciate the fact that aching is more acute in the lower half of the abdomen. The child appears very acutely ill. She usually lies on her back with the legs drawn up on the abdomen, moaning with pain. The pulse is rapid and weak and the respirations shallow because of the discomfiture produced by movement of the abdominal wall in breathing. The temperature continues high. Soon after the onset, the abdomen is rigid and scaphoid. Later, distention is a prominent feature as paralytic ileus develops. The abdominal wall moves poorly with respiration, and peristaltic sounds are usually absent. To the palpating

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hand there is generalized tenderness and muscle spasm over the entire abdomen, more marked in the lower quadrants bilaterally. Rebound tenderness is exquisite and unreferred. Constipation is common, but diarrhea occasionally accompanies the train of symptoms. Leucocyte counts are high, from 20,000 to 40,000, with a marked predominance of polymorphonuclears. Urinalysis is negative unless a transient gonorrheal urethritis is present to confuse the issue.[1, 2, 7]

Besides these abdominal and systemic manifestations, the examiner will usually discover the presence of a vulvovaginitis, acute or chronic. Typically, there will be a profuse, yellowish, purulent vaginal discharge which is positive for gonococci on smear with Gram stain or on culture. The vulva is intensely reddened, edematous, and excoriated, the surfaces stuck together and bathed in the purulent exudate. On rectal examination a sensation of increased heat is imparted to the examining finger, and there is extreme tenderness in both adnexa, as well as tenderness on manipulation of the cervix, but cul-de-sac fluctuation is seldom noted.

Conditions entering into the differential diagnosis most commonly include appendicitis, primary peritonitis (pneumococcus or streptococcus), pyelitis, intussusception, mesenteric adenitis, and Meckel's diverticulitis. A vaginal discharge, past or present, particularly if it can be proved to be of gonorrheal origin, is most helpful in arriving at a diagnosis. An instance is cited, however, in Case 3 where this finding obscured the true process. From the practical standpoint, in the majority of instances, one has to decide the origin of the peritonitis, since it is almost always obvious the patient has a peritonitis. If it can be demonstrated that the infection is of gonorrheal or pneumococcic origin, the treatment is conservative. If, on the other hand, one feels that the process arises from an inflamed appendix, the treatment may become surgical intervention. When one is in doubt and cannot rule out appendicitis, it is certainly to the best interests of the patient to explore. A sudden, precipitious onset with high fever, chills, persistent vomiting, and generalized abdominal pain in an acutely ill child with gonorrheal discharge speaks for gonorrheal extension to the pelvic viscera. Pneumococcic pneumonia, either past or present, in conjunction with this train of symptoms should make one suspicious of a pneumococcic peritonitis. In appendicitis the onset is usually more gradual, the fever is usually not as high and comes on after the pain, the child looks less toxic, vomiting is not as prominent a feature, there is usually more tendency to localization, and no vaginal discharge or evidence of pneumococcic infection can be found. The blood count and sedimentation rate are not helpful in the differential diagnosis. Not infrequently we are confronted with a child with a leucorrhea (particularly common in Negro children) in whom we cannot exclude appendicitis, forcing us to open the abdomen. The operation, however, usually does no harm,

and, in reality, when salpingitis or primary peritonitis is discovered instead of appendicitis, the sulfathiazole sprinkled about in the peritoneum probably does a great deal of good in bringing about a more rapid and complete resolution of the process.

The prognosis in gonorrheal salpingitis and peritonitis is good. Under the usual treatment, the patients are generally clinically cured in ten days or two weeks.

The treatment is conservative—parenteral fluids, sedation, and the usual supportive measures for peritonitis cases in general. Specifically, one gives sulfathiazole or sulfadiazine in the dose of 1 gr. per pound of body weight per day. If the patient is on parenteral fluids and taking nothing by mouth, these drugs may be administered in about the same dose as the sodium salt of the drug intravenously, 1 Gm. dissolved in 20 c.c. of distilled water. In addition, one should vigorously treat the associated vulvovaginitis, preferably with vaginal estrogen suppositories, which bring about cornification of the vaginal mucous membrane and make the area more resistant to the gonococci, as in the adult. Estrogen suppositories have been shown to give more satisfactory results than estrogen given hypodermically or orally. Usually one estrogen suppository (1,000 international units) is inserted once daily for about a week or ten days, then once every two to three days until clinically cured. The danger of sexual precocity with development of secondary sexual characteristics, even in infants, must be kept in mind if treatment is protracted. Usually, 25,000 international units of estrogen is sufficient to overcome the infection.[2, 3, 5, 6]

Case 1 is presented as a rather typical case of gonorrheal peritonitis in a child who was treated conservatively and successfully as just outlined.

A 12-year-old white child was admitted March 18, 1939, complaining of "pain in the stomach." The day prior to admission generalized abdominal pain, nausea, vomiting, chills, and fever began. There was no definite localization or radiation of pain. For the past two to three weeks she had had dysuria, urgency, and frequency, as well as a rather profuse, yellowish vaginal discharge. She had had no previous illnesses and had never menstruated.

Examination revealed a well-developed and well-nourished young white female lying in bed with her thighs flexed on her abdomen, complaining bitterly of abdominal pain. The temperature was 99.2° F.; pulse, 100; respirations, 24. Examination of the tonsils and pharynx was negative, and the heart and lungs displayed no pathologic changes on physical examination. Generalized tenderness and muscle spasm were present over the entire abdomen but more marked in the lower quadrants, particularly on the right side. Unreferred rebound tenderness was noted, but there was no distention or costovertebral tenderness, and no masses were palpated. On rectal examination there was exquisite tenderness in both fornices, as well as tenderness on manipulation of the cervix, but no masses were felt. The vaginal discharge was positive for gonococci. There were no other findings of interest on physical examination.

The laboratory findings on admission were as follows: Blood—white blood cells, 21,450, with 79 per cent polymorphonuclears, 16 per cent lymphocytes, 4 per cent

monocytes, 1 per cent eosinophiles, and 0 per cent basophiles; hemoglobin, 12 Gm. Urine (catheterized)—entirely negative. Vaginal smear—positive for gonococci. Wassermann and Kline—negative.

The history of the sudden onset with chills, fever, urinary symptoms, and lack of localization, as well as the presence of a leucorrhea positive for gonococci with bilateral lower abdominal tenderness and rigidity and exquisite adnexal tenderness, prompted the diagnosis of juvenile pelvic inflammatory disease. Accordingly, the patient was treated conservatively with sulfonamides, theelin suppositories in the vagina, and general supportive measures. The temperature rose to 101.5° F. the day after admission, but it soon fell to normal and remained there throughout the following days in the hospital. The abdominal pain and the tenderness gradually abated and had completely disappeared one week after admission. The leucorrhea rapidly subsided and ceased. Eight days later vaginal smears were negative, and they continued to be negative on several repeated examinations. The patient was discharged April 9, 1939, three weeks after admission, clinically cured.

In Case 2 the patient had a proved gonorrheal vulvovaginitis but the history and abdominal findings strongly suggested appendicitis. Because of this, it was thought safer to operate, since appendicitis could not be reasonably excluded.

A 7-year-old child was admitted July 16, 1941, who had been in good health until July 13, 1941, at which time she began to have anorexia and pains around the umbilicus. On the next day the abdominal pains persisted and vomiting began. The abdominal pain and vomiting persisted up until the time of admission. The mother believed the child had had fever but no chills, and no leucorrhea had been noticed. There had been no urinary symptoms nor any recent upper respiratory tract infection, and the past history was negative.

Examination revealed a well-developed and well-nourished, lethargic, slightly dehydrated young Negro female. The temperature was 99.4° F.; pulse, 125; respirations, 32. Examination of the tonsils and pharynx was negative, and there were no abnormal physical findings in the heart and lungs. Over the entire abdomen there was generalized tenderness and voluntary muscle spasm, apparently more marked in the right lower quadrant. The abdomen was moderately distended and tympanitic, but a few peristaltic tinkles were heard. Unreferred rebound tenderness was present, but there was no costovertebral tenderness, and no masses or organs were palpated. On rectal examination there was tenderness over the peritoneal reflection bilaterally, but no masses were made out. A purulent vaginal discharge was present and was positive for gonorrheal organisms.

The laboratory findings on admission were as follows: Blood—white blood cells, 18,600; with 89 per cent polymorphonuclears, 10 per cent lymphocytes, 1 per cent monocytes, 0 per cent eosinophiles, and 0 per cent basophiles; hemoglobin, 10 Gm. Urine (voided)—acetone, 4 plus; white blood cells, 50 to 60. Urine (catheterized)—acetone, 1 plus; white blood cells, negative. Vaginal smear—positive for gonococci on admission. Wassermann and Kline—negative.

Because of the history of abdominal pain, nausea, and vomiting and the finding of generalized tenderness and rigidity most marked in the right lower quadrant, it was decided, in spite of the presence of a gonorrheal vaginitis, that it was safer to operate, since appendicitis could not be excluded. After correction of the child's dehydration with an intravenous injection of 5 per cent glucose in normal saline, the abdomen was opened on the day of admission. The appendix was found to be small, and only its serosal coat was inflamed. There was a moderate amount of free, thin, seropurulent peritoneal exudate, and the serosa of the large and small intestine in the right lower quadrant was hyperemic and covered with a fibrinous

exudate. Both Fallopian tubes were thickened, hyperemic, and swollen, but no free pus was found exuding from their ends. The appendix was removed in the usual manner, the peritoneum was sprinkled with 2 Gm. of sulfathiazole powder, and the abdomen was closed in layers with interrupted silk without drainage. Postoperatively the patient was kept on intravenous 5 per cent glucose in normal saline, in which was dissolved sodium sulfathiazole, for two days, at the end of which time nourishment was started by mouth which was increased gradually to full diet. Sulfathiazole was continued per os. Local treatment of the vaginitis with estrogen suppositories was instituted. The postoperative course was uneventful. The abdominal symptoms and fever soon subsided after operation, the wound healed per primam, and the patient was discharged completely recovered July 29, 1941 (thirteen days after admission), after three successive negative vaginal smears. The pathologic report was "periappendicitis, acute." A culture of the peritoneal exudate taken at operation was negative on routine culture but on direct smear was positive for gonococci. The patient was seen two weeks after discharge, at which time she appeared to be in perfect health, had no vaginal discharge or other complaints, and the wound was well healed.

Case 3 is cited to illustrate the converse—a case of appendicitis which was misdiagnosed gonorrheal peritonitis, principally because of the presence of a leucorrhea.

A 10-year-old Negro female was admitted Sept. 15, 1942, with a history of a rather sudden onset of generalized abdominal pain beginning two days prior to admission accompanied by chills, fever, nausea, and vomiting. The pains became progressively worse without any definite localization of pain. She had had no recent respiratory infection nor urinary symptoms, and her previous health had been good.

Examination revealed a well-developed and well-nourished young Negro girl who was obviously acutely ill and who appeared to be in extreme distress. The temperature was 103° F.; pulse, 125; respirations, 28. She complained of severe pain in the lower abdomen. Examination of the heart and lungs were negative. The abdomen was scaphoid with marked tenderness and rigidity in both lower quadrants and the suprapubic region, as well as rebound tenderness, not referred. Peristalsis was normal, no costovertebral tenderness was present, and no masses or organs were palpable. Rectal examination revealed extreme tenderness on moving the cervix and in both adnexae, although no masses were felt. There was a profuse, purulent vaginal discharge.

The laboratory findings on admission were as follows: Blood—white blood cells, 25,950, with 80 per cent polymorphonuclears, 17 per cent lymphocytes, 3 per cent monocytes, 0 per cent eosinophiles, 0 per cent basophiles; hemoglobin, 15 Gm. Urine—essentially negative. Vaginal smear—negative for gonococci.

The history of the sudden onset with chills, high fever, bilateral lower abdominal tenderness with the severity of the illness, as well as the marked pelvic tenderness and the profuse vaginal discharge, suggested pelvic inflammatory disease rather than appendicitis. Therefore, a conservative course was adopted. Five per cent glucose in normal saline, to which had been added sodium sulfathiazole, was given intravenously at regular intervals, and other measures were supportive.

This regimen was carried out, but the patient did not improve as expected. For the next two days, the temperature rose to 103.5° F., and on the third day after admission, to 105° F. The profuse vaginal discharge continued, although repeated smears were negative for gonococci. The abdomen continued to be tender and rigid in the lower quadrants bilaterally, and the patient remained acutely ill. There

was occasional vomiting but no distention, and no masses could be felt. She was continued on intravenous fluids, sulfathiazole, and supportive treatment.

On Sept. 19, 1942, four days after admission, it first became evident that the patient was developing a mass in the right lower quadrant which could not, however, be felt by pelvic examination. The diagnosis of ruptured appendix with abscess formation was made and operation performed. The abscess was drained and a perforated appendix removed. From then on the postoperative course was essentially uneventful, and the patient was discharged in good condition Oct. 2, 1942, seventeen days after admission.

SUMMARY AND CONCLUSIONS

1. Gonorrheal pelvic inflammatory disease occurs in young children sufficiently often to be considered in the differential diagnosis of acute abdominal pain in these patients.

2. Typically it is characterized by a sudden onset of signs of acute generalized peritonitis in the presence of a gonorrheal vulvovaginitis.

3. When a definite diagnosis can be made, the treatment is conservative and supportive. The prognosis is good.

4. Three case reports are presented.

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PURULENT PERICARDITIS COMPLICATING PNEUMONIA

Recovery in an Infant Following Therapeutic Aspiration and the Development of Pneumopericardium

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PURULENT pericarditis is a relatively uncommon though serious complication of pneumonia, and the importance of its timely recognition becomes especially impressive when one realizes that the outcome is invariably fatal when the condition remains unrecognized or untreated. Williamson[1] and Shipley and Winslow[2] advocated surgical drainage by means of pericardiotomy as the superior method of treatment, resulting in approximately 50 per cent cures. The latter authors, in fact, stated emphatically, "Operative attack is the only method at one's disposal which offers any chance to cope successfully with the condition." They expressed the belief that the patient who is treated by therapeutic aspiration fares no better than the one who is treated expectantly.

The case here reported, therefore, appears of special interest in that recovery followed a single large therapeutic aspiration and the subsequent gradual development of pneumopericardium, suggesting that both these factors were operative in bringing about the favorable outcome.

CASE REPORT

M. S., a male infant, 8 months of age, was admitted to the hospital Jan. 21, 1939, with the history of an upper respiratory infection which developed three weeks before. Four days earlier, anorexia, restlessness, and respiratory difficulty had appeared rather abruptly.

Initial examination on admission showed a well-nourished infant who appeared acutely ill with dyspnea, cyanosis, and extreme restlessness. Both eardrums were red but not bulging. There was a moderate seropurulent nasal discharge and the faucial structures were injected. The anterior cervical glands were slightly enlarged. The respiratory rate was 48 per minute. There was a lag of respiratory movement on the left. Dullness to flatness was present over the entire left chest both anteriorly and posteriorly associated with bronchial breathing over the upper lobe posteriorly and in the axilla. Crepitant râles were audible over the upper left chest anteriorly and posteriorly. The apex beat could not be palpated, and the heart sounds were scarcely audible. The position and size of the heart could not be determined by physical examination. The abdomen was moderately distended.

The red cell count was 4,540,000, and the hemoglobin was 86 per cent. The white cell count was 25,100, with 9 per cent polymorphonuclear neutrophiles and 77 per cent lymphocytes. The blood Kahn and Mantoux tests were negative.

Roentgen examination of the chest (Fig. 1) taken the day following admission showed a diffuse, homogeneous opacity occupying practically the entire left chest. There was only a small area of transparent lung in the costophrenic angle. A

From the Northern Michigan Children's Clinic.

small patch of pneumonia was present in the right apex. Because of the smooth curve of the right cardiac border with some appearance of broadening at the base, the presence of a pericardial effusion was strongly suggestive. The physical and roentgen findings at the time of admission thus pointed chiefly to a pneumonic process involving the upper lobe of both the right and left lungs and pericarditis with effusion.

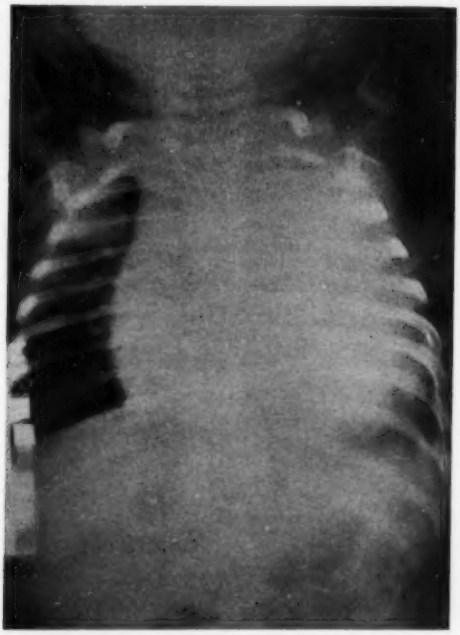


Fig. 1.—Roentgenogram of the chest taken January 22, the day following admission to the hospital, showing marked pericardial effusion. Small patch of pneumonia, right apex. Pericardial paracentesis, January 31; 135 c.c. purulent material aspirated.

On January 24 the patient was put into an oxygen tent because of increased cyanosis and dyspnea. Examination of the chest at this time revealed considerable suppression of breath sounds over the left lower chest posteriorly. A left thoracentesis yielded only 5.0 c.c. of thin blood-tinged fluid, which was sterile on culture. On the following day, the administration of sulfapyridine, 2.0 Gm. daily, was started. During these first few days the patient had a low-grade fever. Although his rectal temperature rarely exceeded 101° F., the patient continued to appear very ill.

On the morning of January 31 the patient's condition suddenly became critical, with the development of marked abdominal distention, increased cyanosis, and labored breathing. The employment of emergency measures including coramine, pitressin, prostigmine methyl salicylate, and turpentine stupes brought some relief. Aspiration of the pericardial sac was then performed, with removal of 135 c.c. of thick, greenish pus, which failed to grow any organisms on culture. A resistant, apparently thickened pericardial membrane was encountered in the paracentesis. Immediate relief followed. With the hope of producing further relief, a second aspiration was attempted later on the same day, but no pus was obtained. A third pericardial tap five days later (February 4) likewise yielded no fluid. At this time sulfapyridine was discontinued, after the patient had received a total of 18 Gm. Improvement of the patient's condition continued.

A checkup roentgenogram of the chest February 8 (Fig. 2) showed the unexpected presence of a moderate amount of air in the pericardial sac. There was still evidence of residual pneumonia in the upper lobe of the left lung. The pneumonic process in the right apex had disappeared. On February 11 another pericardial tap was done. Approximately 10.0 c.c. of air and 2.0 c.c. of thin, sterile, yellowish fluid were aspirated.

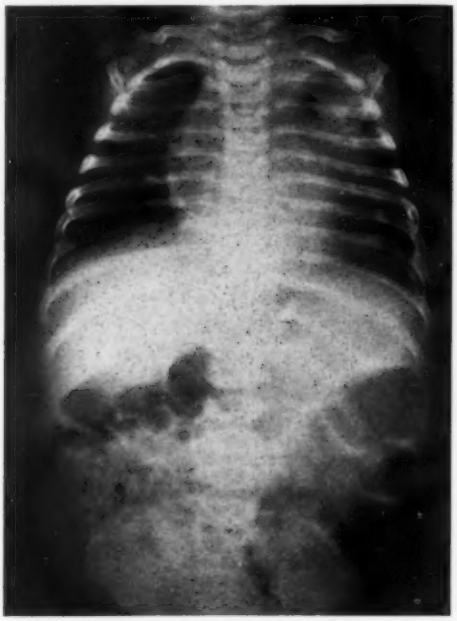
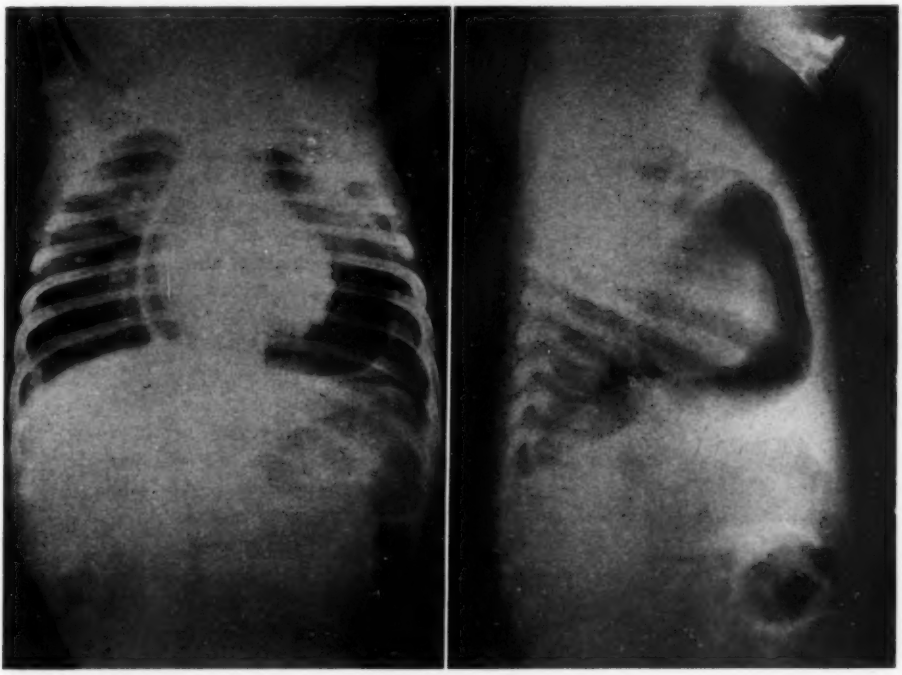


Fig. 2.—Roentgenogram of the chest taken February 8, showing moderate pneumopericardium.

On February 15 roentgen examination (Fig. 3, *A* and *B*) revealed a marked distention of the pericardial sac and compression of the heart by air. There was no evidence of fluid in the pericardial cavity. The upper lobe on the left still showed a pneumonic shadow. Physical examination at this time revealed hyperresonance over the cardiac area with scarcely audible heart sounds.

Two days later, because of the marked, persistent dyspnea, 175 c.c. of air were slowly aspirated from the pericardial sac under the fluoroscope. Immediate improvement in the child's breathing followed. A checkup roentgenogram of the chest five minutes later unexpectedly showed a practically complete refilling of the pericardial sac with air. No further pericardial aspirations were attempted thereafter. The patient steadily improved, his dyspnea gradually disappearing. There was a gradual diminution of hyperresonance over the precordium, and the heart tones became increasingly more distinct. Roentgenologically there was also evidence of a progressive reduction of the pneumopericardium. By March 9 there was a relatively small amount of air in the pericardial cavity (Fig. 4). The pericardium appeared considerably thickened. The pneumonic process in the upper lobe of the left lung appeared to be resolving. Roentgenograms taken March 23, six weeks after the detection of the pneumopericardium (Fig. 5, *A* and *B*), revealed the presence of a small amount of air only in the lateral projection.

The patient was discharged from the hospital April 1 after an attack of measles. Subsequent examinations revealed the infant to be in good health and examination of his heart failed to reveal any abnormalities.



A. *B.*

Fig. 3.—Roentgenogram taken February 15. *A*, Showing marked pneumopericardium with compression of the heart. Pneumonic process, upper lobe, left lung. *B*, Lateral view. Marked reduction of the distended pericardium, following aspiration of 175 c.c. of pericardial air. A roentgenogram taken five minutes later showed a spontaneous, practically complete refilling of the pericardium with air.

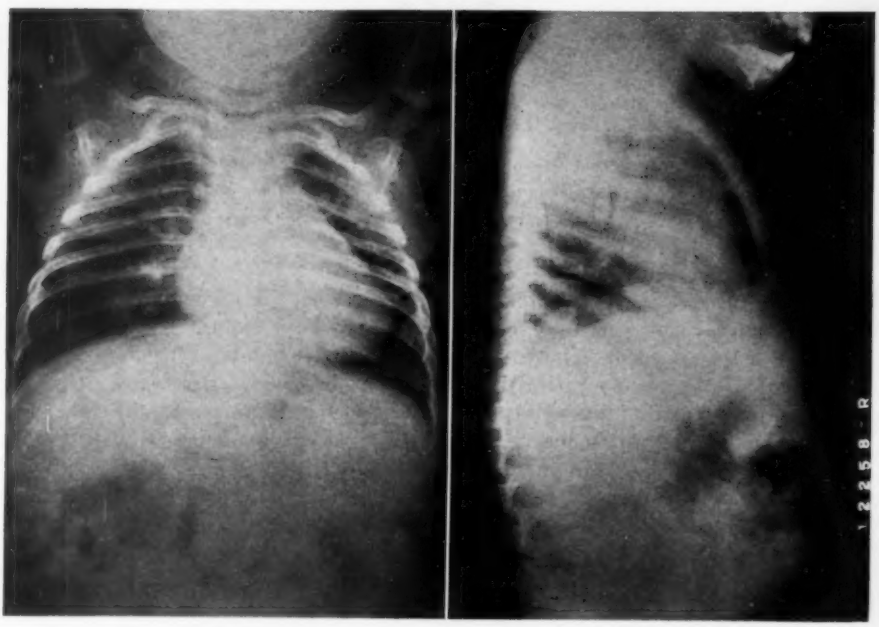
COMMENT

Of interest is the fact that a practically complete evacuation of the pericardial empyema by a single large, therapeutic aspiration occurred without subsequent reformation of pericardial exudate. The development of the pneumopericardium may have been primarily responsible for the failure of the exudate to reaccumulate. Several authors have made the observation that in the treatment of tuberculous pericarditis, the use of therapeutic pneumopericardium apparently has the effect of inhibiting exudate formation.[3] The amount of purulent material removed (135 c.c.), moreover, is large for an infant—in fact, considerably in excess of that found in the majority of instances. In a study of 100 fatal cases of pericarditis complicating pneumonia in children,[4] only in 25 per cent did the amount of pus in the pericardial sac exceed 90 c.c. Usually, according to Holt and McIntosh,[5] the pericardial sac contains not more than from 15 to 30 c.c. of fluid pus.

Fig. 4.

Fig. 4.—Roentgenogram taken March 9, showing considerable diminution of the pneumopericardium. Marked thickening of the pericardial membrane.

Fig. 5.—Roentgenogram taken March 23. *A*, Pericardial air invisible in the frontal projection. *B*, Lateral film shows a small residual amount of air.



A. Fig. 5. *B.*

The occurrence of pneumopericardium in this case presents the interesting question of whether its development was of spontaneous or accidental origin. While the accurate answer is difficult to supply, the slow appearance of the pneumopericardium, as indicated roentgenologically, together with the immediate refilling of the pericardial cavity with air following its removal by aspiration, indicates at least that a fistulous communication had been established between the pericardial sac and the respiratory tract. The occurrence of accidentally induced pneumopericardium as the result of exploratory or therapeutic pericardial paracentesis is relatively uncommon.

A factor exerting an additionally favorable influence in this case was apparently the absence of an associated pleural empyema, for it has been observed[2] that suppurative pleuritis, particularly of the left side, occurring in combination with purulent pericarditis, decreases greatly the patient's chances for recovery. The absence of an associated pleural empyema is in itself an uncommon situation in pericarditis complicating pneumonia.[6] It seems unlikely that sulfapyridine played any dominant therapeutic role in relation to the purulent pericarditis in view of the known relative ineffectiveness of the sulfonamide drugs against pus in a cavity.

Finally, and in nowise minimizing the importance of pericardiotomy in the management of purulent pericarditis, it is difficult to avoid the suggestion offered by the events in this case, that the combined use of aspiration and induced pneumopericardium may together be therapeutically effective. Certainly, such a procedure may well be kept in mind under such circumstances where expert surgical skill is not readily available. The recent results with penicillin offer further suggestion that it may be of important, additional value in such a situation.

SUMMARY

An instance is reported of a recovery from purulent pericarditis in an 8-month-old infant following a single large, therapeutic aspiration of the pericardial sac and the subsequent, gradual development of pneumopericardium, both of which factors appear to have operated together in bringing about the favorable outcome. The suggestion is derived from the events in this case that therapeutic aspiration followed by induced pneumopericardium may, under certain circumstances, serve as a conservative method of treatment in purulent pericarditis.

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RHEUMATIC PERICARDITIS IN EARLY CHILDHOOD

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RHEUMATIC heart disease in infancy and early childhood is considered to be relatively uncommon, but even more unusual may be regarded the appearance of rheumatic pericarditis as the initial manifestation of rheumatic fever at this age. For this reason the case report of a child, apparently the youngest patient to have recovered from rheumatic pericarditis, is worthy of being recorded.

History.—G. E., a colored male child of 2½ years of age, was admitted to Lincoln Hospital Dec. 17, 1942. The child had been perfectly well until the night of Dec. 16, 1942, when he suddenly complained of severe generalized abdominal pains. Four hours later he felt feverish and developed severe labored respirations. There was no history of vomiting, cough, or diarrhea. The past history was essentially negative, particularly with reference to any manifestations of rheumatic fever. In infancy he had had eczema as a result of orange juice. The family history was negative, although the mother was being treated for hay fever and asthma.

Physical Examination.—Physical examination revealed an acutely ill child with dilation of the alae nasae and labored respiration. The other positive physical findings were hypertrophied congested tonsils and an injected pharynx; the abdomen was moderately distended and somewhat rigid but with no localized tenderness. The rectal examination elicited marked tenderness on the right side. The heart showed a tachycardia but no other findings, and the lungs appeared clear to auscultation and percussion. Temperature, 102° F.; pulse, 170; respirations, 60; blood pressure, 100/70.

Laboratory Data.—Examination of the blood showed the following: red cell count, 4,600,000; hemoglobin content, 12 Gm.; leucocyte count, 17,000, of which 92 per cent of the white cells were polymorphonuclears and 8 per cent lymphocytes. Examination of the blood smear and of fresh blood was negative for sickling. The urine showed 2 plus albumin, occasional leucocytes, occasional red blood cells, and a few granular casts. Blood chemistry determinations showed the following: nonprotein nitrogen, 26; total protein, 6.5; sugar, 88; and carbon dioxide, 46 per cent. The erythrocyte sedimentation rate (Westergren) was 120 mm. per hour. A blood culture, Wassermann, and Mantoux of 1:1,000 were negative. A roentgenogram of the chest on admission was negative for any pathology in the heart and lungs (Fig. 1).

Diagnosis and Course.—The sudden onset of the illness with abdominal pain and the subsequent acute toxic distress of the child suggested an acute condition of the abdomen requiring surgery. A peritoneal and spinal tap revealed no abnormal findings. The surgical staff in consultation did not feel a surgical abdomen existed. On the afternoon of Dec. 18, 1942 (the day after admission), one of us (S. L. E.) noted a diminution of percussion anteriorly and posteriorly in the left lower lung field with a corresponding decrease in breath sounds and interpreted

From the Pediatrics Service of Dr. Harry S. Altman, Lincoln Hospital.

this as an early lobar pneumonia. Another roentgenogram of the chest was therefore taken later on the same afternoon in view of these suggestive lung findings, although the initial x-ray picture of the chest had been negative. This x-ray picture (Dec. 18, 1942) showed a marked enlargement of the cardiac silhouette, especially on the left side, and clear lung fields which immediately suggested the diagnosis of pericarditis (Fig. 2). An electrocardiogram taken directly and interpreted by Dr. Goldberger of the Cardiology Department confirmed the clinical

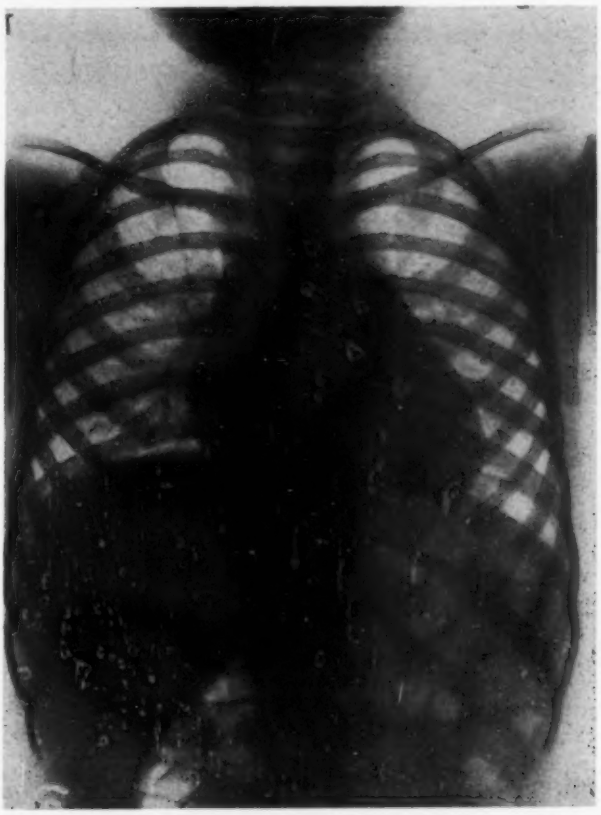

Fig. 1.—Roentgenogram taken on admission, Dec. 17, 1942; reported negative.

impression of rheumatic pericarditis (elevated RS-T segments in Leads I, II, and III, Fig. 3). The heart at this time was enlarged, the heart sounds did not appear muffled, a friction rub was not heard, and no murmurs were present. The child was severely dyspneic, the abdomen was still spastic, and he still complained of abdominal pains.

Five days after admission, despite large doses of salicylates, the size of the heart continued to increase. The child was very dyspneic even in the oxygen tent, and restlessness had to be controlled with morphine and with sodium phenobarbital. Rapid digitalization was employed when the liver became tender, and the first evidences of congestive failure presented themselves, but no appreciable effect from this medication was noted. A pericardial tap was done on the sixth day to

determine the character of the fluid: 10 c.c. of clear, straw-colored fluid were drawn which proved to be sterile on smear and culture but showed a leucocyte count of 8,000, of which 80 per cent were lymphocytes.

A pericardial friction rub and muffled heart sounds were first heard one week after admission when the clinical findings and the x-rays indicated an increase in the size of the heart. The patient's general condition became much worse, and on the fourteenth day a 2 plus edema of the ankles appeared. The toxic appearance of the child present on admission continued for sixteen days, but from Jan. 4, 1943 (seventeenth day) on he began to improve; the edema of the ankles subsided, the dyspnea disappeared sufficiently to enable him to stay out of the oxygen

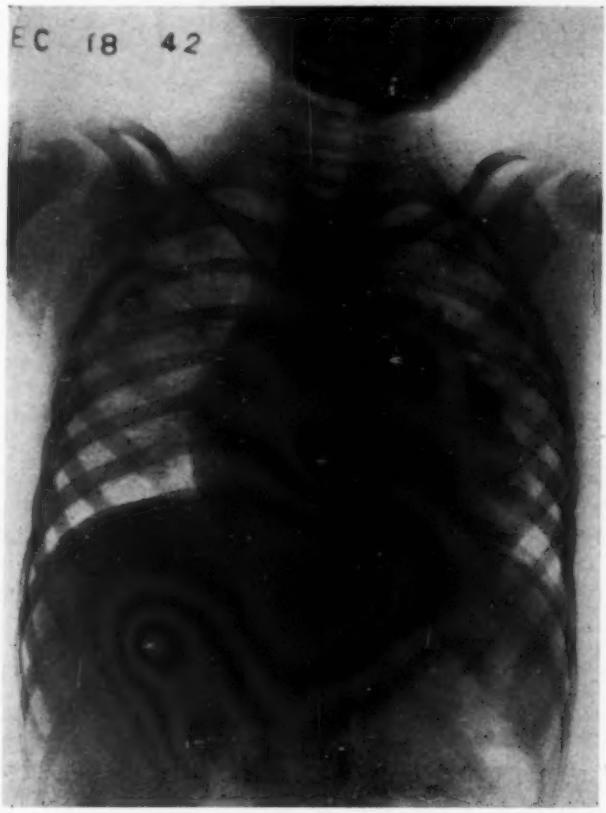

Fig. 2.—Roentgenogram taken the following afternoon, Dec. 18, 1942, showing marked enlargement of the cardiac shadow, especially on the left side.

tent, and the toxicity decreased. On Jan. 8, 1943 (twenty-first day of illness) he appeared quite alert, cheerful, and comfortable, the edema had all gone, and he sat up in bed. A soft systolic murmur not transmitted was heard for the first time at the apex, and the cardiac shadow on x-ray appeared normal in size except for widening of the superior portion of the heart. The child continued to improve steadily, and he was discharged to his home March 18, 1943, because he contracted mumps. A faint soft systolic murmur at the apex, not transmitted, was the only indication of possible cardiac damage at the time of discharge.

The erythrocyte sedimentation rate which was 120 mm. per hour on admission, remained elevated for two weeks, then gradually dropped to 35 mm. per hour Jan. 11, 1943, and finally reached normal Feb. 23, 1943 (about two months after admission), remaining so until the termination of his hospital stay. The leucocyte

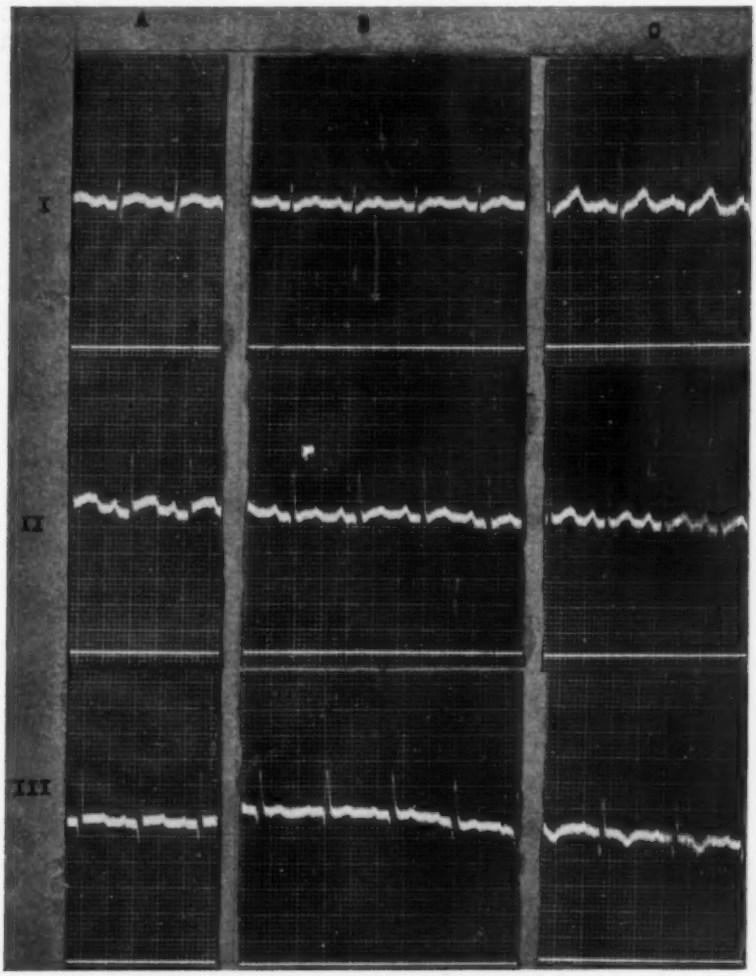

Fig. 3.—*A*, Electrocardiogram taken Dec. 19, 1942, showing elevation of RS-T segment in all leads; P-R interval, .14, indicative of pericarditis.

B, Electrocardiogram taken Dec. 24, 1942, showing a return of the RS-T segments to the isoelectric line.

C, May 28, 1943. Follow-up electrocardiogram taken two months after the child's discharge from the hospital is normal.

count, which on admission was 17,700, with 92 per cent polymorphonuclears, indicating an acute infectious process, gradually went down to normal Jan. 11, 1943, and remained so. The urine showed evidence of kidney irritation for the first three days and then remained normal.

The temperature, which was 102° F. on admission, ranged between 100 and 101° F. for the first nineteen days, even though the child received large doses of salicylates, and then became normal for the balance of the hospitalization period.

Subsequent Course.—The child was discharged from the hospital to his home in excellent condition except for mumps. A follow-up examination May 28, 1943, disclosed that he was in good condition, experiencing only slight dyspnea after considerable walking. The heart revealed only a soft apical systolic murmur which was not transmitted. An x-ray of the heart, electrocardiogram, erythrocyte sedimentation rate, and urine and blood examinations were all negative.

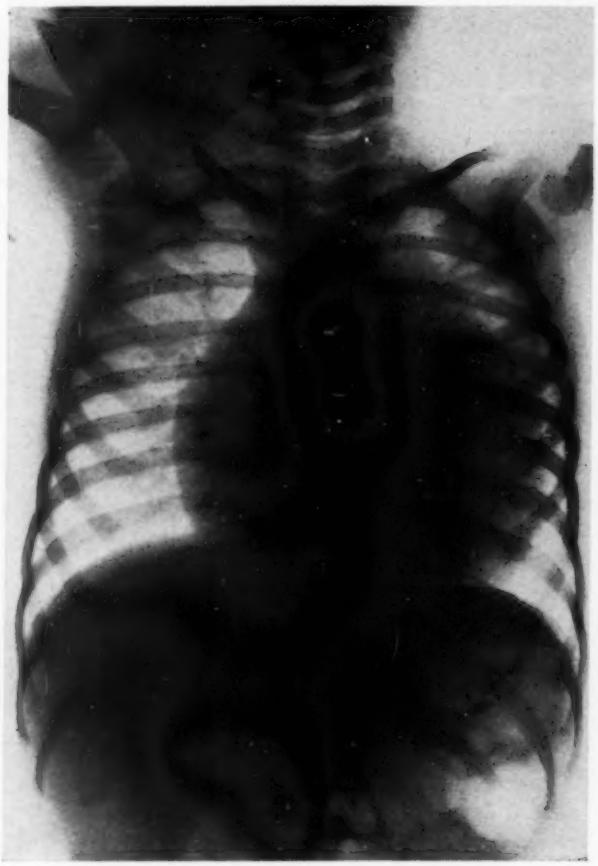

Fig. 4.—Roentgenogram taken Dec. 24, 1942, showing maximum enlargement of the cardiac shadow.

He was admitted to a convalescent home June 22, 1943, and after a stay of one month, he was sent to Willard Parker Hospital because of measles. The last follow-up examination Sept. 21, 1943 (nine months after onset of illness), found the child to be in good physical condition and able to play as actively as other children, feeling a bit tired only after considerable exertion. Again an x-ray of the heart, electrocardiogram, erythrocyte sedimentation rate and urine and blood examinations were essentially normal.

REVIEW OF THE LITERATURE

Rheumatic heart disease in children under the age of 3 years is relatively uncommon, although during the past two decades it has been reported somewhat more frequently than in the past. This, of course, may be due to our finer present-day diagnostic methods of determining rheumatic diathesis in the child and to the more precise and careful histologic examination of tissues in patients with suspected rheumatic heart disease.

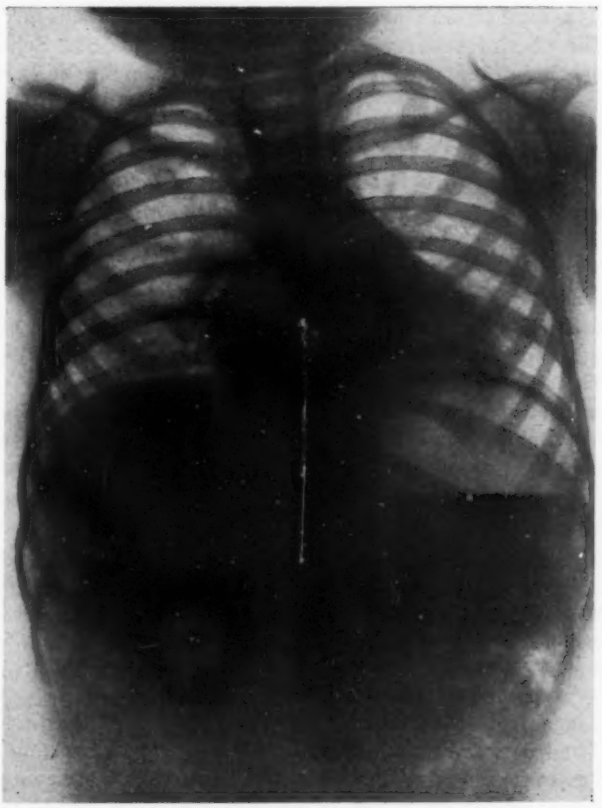

Fig. 5.—Roentgenogram showing return of the cardiac shadow to normal Feb. 2, 1943.

Fisher[1] mentions that Schroeder[2] reported a case in a patient aged 20 months, Denzer[3] recorded two cases of mitral stenosis in children 23 months and 2 years, respectively, White[4] reported a rheumatic heart condition in a 16½-month-old child, and Ingerman and Wilson[5] found two patients in a series of 185 under 3 years of age. However, Holt[6] found no subject with endocarditis under 3 years of age in a series of 1,000 post-mortem examinations. Still[7] did not see a single patient

under 2 years of age and only eight under 3 years of age among 1,027 children with articular and cardiac rheumatism or with chorea. Coombs[8] found no case of rheumatic heart disease under 3 years of age in his series of 687 cases. In his own case report of a child having rheumatic heart disease at 1 year of age, Fisher[1] states that the mother had rheumatic fever from the third to the seventh month of the child's fetal life.

Kissane and Koons[9] claim that intrauterine transmission of rheumatic fever and heart disease is not only probable but possible and report their case of a child being born with red, painful, and swollen joints of a mother who had rheumatic fever throughout pregnancy and at the time of delivery. They quote Powell in 1882, Schaefer in 1886, Guthrie in 1888, and Ferguson in 1893 as reporting cases of rheumatic fever in infancy.

Poynton and Paine[10] also reported a child, 2 days old, on whose mitral valve diplococci were recovered from the vegetations, the mother having been a victim of rheumatic fever during the late months of pregnancy. Autopsy in this case showed the typical picture of rheumatic valvulitis.

Paul[11] emphasized the rarity of rheumatic fever in infants under 2 years of age with his statement that a total of forty cases have been reported in the literature in which the patients were under 1 year of age, most of whom were nursed by mothers suffering from acute phases of the disease.

McIntosh and Wood,[12] in a twenty-five-year survey of rheumatic infections at Babies Hospital, found only twenty-four cases in which it was felt that the disease appeared to have begun before 3 years of age, and of interest was their finding that in no instance "was there a history of simultaneous rheumatic fever in the home."

Rheumatic pericarditis as an initial manifestation of early rheumatic fever is unusual. Although seven cases of fetal pericarditis have been reported in the literature, Killian[13] notes that in none of the patients could a rheumatic infection be demonstrated, whereas syphilis was believed to be a more likely etiologic factor in the majority.

Kaiser[14] reported thirty-three children with rheumatic fever under 2 years of age from a series of 1,125 cases. None of the thirty-three children had pericarditis and effusion. Hedley,[15] summarizing a study of 4,653 cases from Philadelphia hospitals, noted there were no patients under 1 year of age, seventeen during the first year, and thirty-seven during the second year. None of these patients had pericarditis.

Among the youngest patients with rheumatic pericarditis on record is that of a 3-year-old child included in a report by Antell[16] of a series of nine cases of rheumatic pericardial effusion. The youngest patient in a series reported by Massie and Levine[17] was also 3 years of age.

In one of the finest studies on the prognosis and subsequent developments in acute rheumatic pericarditis, Massie and Levine[17] mention an immediate mortality of 16.3 per cent in a series of 135 cases covering

the years 1913-1937; twenty-five patients, after recovery from the initial infection, died after an average interval of 6.7 years. Extremely interesting was their finding that 36 per cent of their patients on follow-up showed no evidence of organic heart disease, and an additional 14 per cent had only mitral insufficiency; even after a desperately severe attack of acute pericarditis, recovery was often complete; x-ray or clinical evidence of constrictive pericarditis did not occur in any instance; injury to the heart valves was the most important factor in the subsequent prognosis.

Findlay, MacFarlane, and Stevenson,[18] however, agree with Still, that the immediate and remote prognosis of rheumatic pericarditis in childhood is serious after finding that twenty-six of fifty-one patients died; and in only eight patients of the remaining twenty-five was there no subsequent evidence of cardiac disability. The earliest age at which they could diagnose the condition of rheumatic pericarditis was 5 years; but they felt from post-mortem examination that the mischief must have commenced at a much earlier date.

COMMENT

This case, in addition to being that of the youngest patient to have recovered from rheumatic pericarditis, presented other interesting features. During the first two days of admission the child's complaints of abdominal pain and the picture of toxemia were so strongly suspicious of an acute condition of the abdomen requiring surgery that the surgeons were called into consultation twice. Lyon,[19] in 1934, called attention to the fact that an acute attack of pericarditis may simulate acidosis, toxemia, or an acute condition of the abdomen requiring surgery.

The first clue leading to the correct diagnosis was the repeat x-ray of the chest taken the day after admission, when physical signs presented themselves at the left base which were first interpreted as evidence of early consolidation of the left lower lobe. This x-ray, when compared to the normal x-ray of the chest taken on admission, showed such a pronounced increase in the cardiac silhouette that the diagnosis of pericarditis was indicated. An electrocardiogram taken the following day confirmed the diagnosis of pericarditis with effusion by the characteristic elevation of the S-T segments in the various leads. This elevation quickly returned to the isoelectric line five days later.

From the standpoint of therapeutics the most effective measures in making the child comfortable were oxygen and sedation with small doses of morphine and sodium phenobarbital. The administration of salicylates in full doses was ineffective in either bringing the temperature down or making the patient more comfortable. Digitalis, which was given when signs of early decompensation appeared, was not able to slow down the pulse, and whether it actually influenced the early congestive heart failure could not be definitely determined.

In view of the extreme gravity of the child's condition during the first seventeen days of his hospital stay, it was amazing to note his rapid improvement thereafter and the remarkably little residual damage done to the cardiac structures, for nine months after hospital admission he presented only a soft apical systolic murmur which was not transmitted.

SUMMARY

1. A colored male child 2½ years of age is reported as the youngest patient on record to have recovered from rheumatic pericarditis.

2. In the early stages of the disease rheumatic pericarditis may offer a difficult diagnostic problem.

3. Oxygen and sedation proved to be more effective therapeutic agents than salicylates in making the patient comfortable.

4. The severity of the illness does not necessarily indicate a serious prognosis in rheumatic pericarditis provided the valves of the heart have not been badly damaged.

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WHOOPING COUGH MORTALITY

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WHOOPING cough can be a serious problem, especially in the young child. Although we were aware of this because of our work in a fever hospital, we did not fully appreciate the seriousness of the situation until recently, when we had occasion to review our whooping cough data for the past ten and one-half years.

"Of all the infectious diseases of childhood that occur in epidemic form, perhaps none is more important from the point of view of both morbidity and mortality than is whooping cough. The disease occurs both endemically and in epidemics and is most serious when complicated by secondary pulmonary infections; these are produced as a rule by those organisms that commonly inhabit the upper respiratory tract."[1]

During the period from Jan. 1, 1933, to June 30, 1943, we hospitalized 362 children because of whooping cough in the Isolation Hospital of the Milwaukee Health Department. Table I shows the incidence according to years and also that the disease increases every three to four years. Table II illustrates the distribution according to age and emphasizes the high percentage of children less than 1 year of age. There were approximately twice as many infants under 1 year than there were children between 1 and 2 years of age, and these first two years together represented one-half of the cases. This age distribution is different from that for the city of Milwaukee as a whole. The data from the City Health Department also are given in Tables I and II and establish the same cycle by years, but the incidence by age increases progressively to reach a maximum for the 5-year-old group.

In addition, in Tables I and II, the fatalities for each year and for each age group are given. At the South View Hospital there were thirty-one deaths among the 362 patients, a mortality of 8.6 per cent. For the city as a whole there were seventy-five deaths out of the total 29,845 patients, or 0.25 per cent. It is thus apparent that the more critically ill cases were brought into the Isolation Hospital. This difference in mortality rates for the hospital and for the city might provide an exaggerated point of view in regard to the problem of whooping cough, but there is no doubt that the seriousness of the situation for the younger age group is established.

In analyzing the details of Tables I and II it is obvious that by far the greatest number of deaths occurred in the youngest children. At the South View Hospital, twenty-three of the thirty-one fatalities were in infants less than 1 year of age, while for the city at large fifty-

From the South View Contagious Disease Hospital for the Milwaukee Health Department, and the Department of Internal Medicine, Marquette University School of Medicine.

TABLE I

INCIDENCE OF WHOOPING COUGH BY YEARS

YEAR	SOUTH VIEW HOSPITAL		CITY OF MILWAUKEE	
	NUMBER OF CASES	NUMBER OF DEATHS	NUMBER OF CASES	NUMBER OF DEATHS
1933	38	3	3,488	12
1934	26	2	3,607	8
1935	26	2	2,787	7
1936	21	4	3,120	14
1937	7	0	1,638	4
1938	75	4	5,179	7
1939	48	2	2,170	5
1940	7	1	558	1
1941	41	5	3,768	8
1942	57	5	2,351	6
1943*	16	3	1,179	3
Total	362	31	29,845	75

*Data for only six months.

four of the total seventy-five deaths were in infants during the first year of life. Thus in each group of patients, those seriously ill at the hospital and those for the entire city, more than 70 per cent of the deaths were in infants less than 1 year of age. Since there had been 118 patients less than 1 year old at the hospital, the mortality rate for these seriously sick infants was approximately 20 per cent.

TABLE II

DISTRIBUTION OF WHOOPING COUGH BY AGES

AGE (YR.)	SOUTH VIEW HOSPITAL		CITY OF MILWAUKEE	
	NUMBER OF CASES	NUMBER OF DEATHS	NUMBER OF CASES	NUMBER OF DEATHS
Under 1	118	23	2,229	54
1 to 2	61	2	2,745	11
2 to 3	33	1	3,293	4
3 to 4	50	1	3,789	2
4 to 5	27	2	3,979	2
5 to 6	23	1	4,296	2
6 to 7	22	1	4,031	0
7 to 8	13	0	2,486	0
8 to 9	7	0	1,308	0
9 to 10	2	0	681	0
Over 10	3	0	847	0
Unknown age	3		161	
Total	362	31	29,845	75

There is, therefore, reason to be concerned about safeguarding such children in the future. There are two approaches to the problem: concentration on better therapeutic measures for the children who are ill, and prevention of the disease by prophylactic procedures. It would seem to be wiser to stress the latter aspect of the situation since prophylactic measures offer more opportunities for relief than are afforded by present therapeutics. The wisest course is to protect these young infants so that they will not have to undergo the hazard of this serious infection.

For the past several years immunization against whooping cough has been tested by many workers using both clinical and experimental

procedures. Recent work in this field has been briefly but comprehensively reviewed by Fisk.[2] With improved techniques for the preparation of the vaccine and the use of phase I strains of *Hemophilus pertussis*, vaccinations have resulted in from 85 to 100 per cent successful protection, while control groups have suffered as high as 75 per cent incidence of the disease. Former failures in immunization appear to have been due chiefly to the type of vaccine used, although age at the time of vaccination has been considered an important factor.

Sauer[3] was one of the first to investigate the effect of the age of the infant upon his response to pertussis antigens. In 1941 an abstract was published of a paper which he presented before the Chicago Pediatric Society. He stated at that time that he had found whooping cough seven times more frequent in children vaccinated before 3 months of age than in children vaccinated after 7 months of age. His conclusions were based chiefly upon the results of two questionnaires sent out by the Cradle* and by a hospital in Geneva, Ill. The infants from the Cradle served as controls for immunization at the younger age. Since Sauer stated that their immunization program was completed before they were 3 months of age, we assume that he employed his early policy of vaccinating three times, at weekly intervals, beginning when the infants were from 1 to 2 months of age. Only ninety-one of 1,110 of these infants contracted whooping cough during the subsequent four years, whereas the incidence of whooping cough among the infants vaccinated at the hospital clinic after 7 months of age was only 1.44 per cent. It is thus apparent that, although the infants who were 7 months old or more at the time of immunization had better protection and those in the younger group had seven times more whooping cough, obviously vaccination at the younger age period accomplished a great deal, for more than 90 per cent of the infants in the younger age group were adequately protected.

The effect of age upon response in whooping cough immunization was studied in more detail by Keller, Peterson, and Densen.[4] They gave five weekly treatments (20 billion organisms per 1 c.c. for each injection) to a series of 381 children varying in age from 6 weeks to 3 years. They used the opsonocytophagic reaction of Kendrick and Eldering[5] as a test of their results. They commented as follows: "It is particularly noteworthy that very young infants, 6 weeks or more, seemed able to tolerate large injections of vaccine without reactions or serious consequences. Children under 3 months did not respond quite as rapidly as children over 3 months of age. In general, the older the child the more rapidly a rise in phagocytic activity could be evoked. It was also noted, however, that the degree of phagocytosis prior to vaccination varied with age in the same manner as the results of the opsonocytophagic tests after vaccination. This would suggest that perhaps in the younger infants there was a lack of previous nonrelated infections which could serve as stimuli which would condition their response to vaccination.

*An organization at Evanston, Illinois, for the placement of young infants in foster homes.

The rapidity with which the opsonocytophagic response could be induced varied with age, but the capacity to respond seemed the same for all the ages investigated with the exception of children under 3 months of age." These authors also gave stimulating doses to forty-eight of their patients, administering a single injection of 10 or 20 billion organisms from six to twelve months after the initial immunization. They found that a very substantial increase in the opsonocytophagic response could be produced.

Miller and co-authors,[6] in 1943, published a study of an agglutinating reaction for *H. pertussis* for 215 children vaccinated between the ages of 6 months and 3 years. They recommended vaccination with a total of 80 billion organisms, to be given usually in three divided doses at from seven- to ten-day intervals. They found that a plateau of antibody titer was reached in from two to four months which would remain fairly constant for several years without a tendency to decline. Prolonging the interval between injections had no appreciable effect on the height or persistence of agglutinins, whereas revaccination one year or more after the original vaccination led to increases in agglutinin titer which were maintained at high levels for at least three years. Interestingly, the children who were vaccinated when over 3 years of age developed slightly lower plateaus of agglutinins than did the younger children.

In 1942 Miller and associates[7] reported an investigation of concurrent immunization against tetanus, diphtheria, and pertussis. They found that consistently higher levels of agglutinins for *H. pertussis* were produced when alum-precipitated toxoid was given concurrently with the pertussis vaccine than when vaccine was given alone.

On the basis of the above work we would like to suggest the following program for immunization against whooping cough: (1) begin vaccination when infants are 3 months of age; (2) give 80 billion organisms in three divided doses, at from seven- to ten-day intervals; (3) administer a stimulating dose of pertussis vaccine concurrently with diphtheria immunization toward the end of the first year.

CONCLUSION

We would like to emphasize that because of the high incidence of whooping cough among infants and because of the seriously high level of mortality for those who contract the disease at this age, early prophylactic measures to protect them would seem to be vitally important.

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FULMINATING MENINGOCOCCEMIA
(THE WATERHOUSE-FRIDERICHSEN SYNDROME)

Report of Three Cases With Autopsy and One With Recovery

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THE clinical entity of fulminating septicemia with purpura and shock has usually been considered indicative of bilateral adrenal hemorrhage and is called the Waterhouse-Friderichsen syndrome. Little, in 1901, was the first to recognize that the symptoms were so similar and constant as to constitute a clinical entity. In 1906 Andrews reported the first proved case. Waterhouse reviewed the literature in 1911 and added some cases of his own. In 1918 Friderichsen added several more cases and brought the literature up to date. The term Waterhouse-Friderichsen syndrome was first applied in 1933.

In recent years four cases with recovery have been reported in the literature. In the past seven months at the Children's Memorial Hospital we have seen four patients with this syndrome, three of whom died and one who recovered.

Case 1.—A 2-year-old white boy was well until the morning of May 1, 1943, when he awoke with a high fever and listlessness. Two hours later he was seen by a doctor who, thinking he had meningitis, rushed him to the hospital. On the way he developed a hemorrhagic rash.

On admission he was comatose, the temperature was 106.4° F., the radial pulse was unobtainable, and his respirations were 36. He was cyanotic and there were many large purpuric lesions over the entire body. The extremities were cold and clammy. The neck was not stiff and both Kernig and Brudzinski signs were negative. The deep reflexes were brisk.

He was given 2½ gr. of sodium sulfadiazine per pound intravenously as an initial dose, followed by ¾ c.c. of epinephrine hydrochloride 1:1000 and 250 c.c. of human pooled serum. Immediately following the epinephrine he seemed to improve slightly. His color was better, the respirations were stronger, and the radial pulse was palpable. The improvement was of short duration for he expired about four hours after admission. Blood and spinal fluid cultures were positive for meningococci.

Autopsy revealed the brain and meninges to be normal, a large reddish purple thymus, and massive hemorrhage into both adrenal glands.

Case 2.—A 2-year-old white girl was well until the early morning of Oct. 5, 1943, when she awoke crying and had fever. The temperature ranged between 104 and 106° F. all day, and in the evening a doctor was called. He prescribed 2½ gr. of aspirin and some "pink pills" three times daily. The following morning the temperature was 98° F. During the morning she vomited, became worse, and did not recognize her mother. She was then brought to the hospital.

She appeared to be acutely ill with a temperature of 100.2° F. The eyes were fixed and staring. Her throat was markedly injected. There was slight nuchal rigidity. The Brudzinski sign was positive and the Kernig sign was negative. Petechiae were present on the trunk and extremities. The impression was meningococcic septicemia.

From the Children's Memorial Hospital.

The child was given sulfathiazole, about 3 gr. per pound, in a twenty-four-hour period. The following day she began vomiting. In the afternoon she was given a blood transfusion and she seemed improved. After twenty-four hours she began vomiting again; at this time intravenous fluids were started. At 3:30 P.M. she had a slight convulsion. At 4 P.M. her temperature rose abruptly to 106.2° F. Several hours later the pulse became irregular and faint and the respirations deep and slow, and many large purpuric lesions appeared on the abdomen and lower extremities. She expired ten hours after the sudden change in her condition.

Autopsy examination revealed a purulent exudate along the vessels of the brain. Culture revealed meningococci. The adrenals had a dark red, almost black, hemorrhagic appearance.

It seems likely that the adrenal hemorrhage occurred shortly before the abrupt change in the patient's condition.

CASE 3.—A 2½-year-old white boy was well until the morning of Oct. 12, 1943, when he awoke crying, had a temperature of 105° F., vomited, and lapsed into coma. Several hours after the onset he was brought to the hospital.

Examination revealed a comatose patient who had several mild convulsions. The temperature was 106.6° F. and respirations were 40. The radial pulse was unobtainable and the blood pressure could not be recorded. The eyes were fixed and staring. The throat was moderately injected. There was no nuchal rigidity. The Kernig and Brudzinski signs were positive. A few tiny petechiae appeared during the examination.

He was given 2 c.c. of adrenal cortical extract intramuscularly, sponged to lower the temperature and a cannula put in the right ankle vein by a "cut down." Sodium sulfadiazine, 75 gr., was given intravenously as an initial dose, followed by a continuous slow drip of 500 c.c. of 5 per cent dextrose in normal saline solution to which had been added 5 c.c. of adrenal cortical extract. About one hour later the temperature had risen to 108.2° F. and convulsions were more severe and more frequent. The skin was cyanotic, cold, and clammy and the radial pulse thready, and large purpuric areas were appearing over the trunk and extremities.

He was given 25,000 units of penicillin intravenously and another 75 gr. of sodium sulfadiazine and epinephrine subcutaneously, placed in an oxygen tent, and given more adrenal cortical extract. However, he expired about sixteen hours after the onset of his illness.

Post-mortem examination revealed extensive hemorrhage into both adrenals and early acute leptomeningitis.

CASE 4.—An 8½-year-old white boy was well until 6:00 P.M. Nov. 19, 1943, when he developed fever and pain in his back. The next morning he complained of a sore throat and an earache. He vomited twice. About eight hours before admission the mother noticed petechiae on his arms and legs; some hours later they covered the entire body. About 3:00 P.M. he became comatose and at 3:30 P.M. he had a convulsion. He remained in coma and was brought to the hospital at 6:00 P.M. November 20.

One week before the onset of this boy's illness a 7-year-old sister became ill with fever, headache, vomiting, and spots. She was not seen by a doctor but improved after several days and was almost well at the time her brother was admitted to our hospital.

Examination revealed a well-developed and well-nourished comatose boy who had mild twitching of the hands, rapid, shallow, irregular respirations, cold and blue extremities, and bluish purpuric spots all over the body varying in diameter from 1 mm. to 2 cm. The radial pulse was imperceptible and the blood pressure could not be recorded. The temperature was 104° F. Both ears and the throat were injected.

Petechiae were observed in the buccal mucosa and in the conjunctivae. The heart rate was 160. There was marked nuchal rigidity and both Kernig and Brudzinski signs were markedly positive. The impression was meningococcic septicemia with meningitis. Waterhouse-Friderichsen syndrome was suspected. Smears taken from petechiae contained one or two suspicious gram-negative diplococci. The blood culture was positive for meningococci.

Treatment consisted of the immediate administration of 2 c.c. of adrenal cortical extract intramuscularly and 1 c.c. of adrenalin chloride subcutaneously. A blood culture was taken and later reported as being positive for meningococci. Five hundred cubic centimeters of 5 per cent dextrose in saline was started intravenously with 5 Gm. of sodium sulfathiazole and 10 c.c. of adrenal cortical extract added to the flask. About forty-five minutes later, 1 c.c. of adrenalin was given hypodermically, but the blood pressure still could not be recorded. At 9:00 P.M. a second flask of 5 per cent dextrose in normal saline with 7 c.c. of adrenal cortical extract was given intravenously. The systolic blood pressure was 80. At 9:30, three hours after the first dose, 5 Gm. of sodium sulfathiazole was again given. At midnight the radial pulse was still imperceptible.

On November 21, at 2:00 A.M., 2 Gm. of sodium sulfathiazole and 100 mg. of cevalin were given intravenously together with a third flask of 5 per cent dextrose in normal saline and 10 c.c. of adrenal cortical extract. The blood pressure was 72/50. At 2:15 A.M. 1 c.c. of adrenalin was given hypodermically. At 2:30 A.M. the blood pressure was 84/62; at 3:30 A.M. it was 76/54. At 3:35 A.M. 1 c.c. of adrenalin was given hypodermically and at 6:00 A.M. 2 Gm. of sodium sulfathiazole were given. At 8:00 A.M. ½ c.c. of cortate was given intramuscularly. The blood pressure was 84/50 and very little cyanosis was present. At 10:00 A.M. 2 Gm. of sodium sulfathiazole were given and at 11:30 A.M. ½ c.c. of cortate was administered intramuscularly. The condition seemed somewhat improved. The pulse was stronger and respirations more regular. At 12:30 P.M. the blood pressure was 72/50. At 1:45 P.M. 1 c.c. of cortate was given intramuscularly. At 2:00 P.M. sodium sulfathiazole, 2 Gm., was given. At 6:00 P.M. 1 c.c. of cortate was given intramuscularly. At 8:00 P.M. sodium sulfathiazole, 2 Gm., was given. When spoken to the patient seemed to respond. At 11:30 P.M. 1 c.c. of cortate was given intramuscularly.

On November 22, at 2:00 A.M., sodium sulfathiazole, 2 Gm., was given and at 3:30 A.M. 1 c.c. of cortate was given intramuscularly. At 8:00 A.M. the patient's color was better, he responded well, his pulse was strong, and respirations were regular. There was no cyanosis. Purpuric spots were smaller and fewer in number. At 10:00 A.M. ½ c.c. of cortate was given. The blood sulfathiazole level was only 8.3 mg. per 100 c.c. despite a total dose of 24 Gm. in thirty-eight hours. At 2:00 P.M. ¼ c.c. of cortate was given and at 7:00 P.M. another ¼ c.c. At 11:15 P.M. ½ c.c. of cortate was given. On November 23, at 4:00 A.M., 1 c.c. of cortate was given hypodermically.

The total dosage over a period of fifty-eight hours was as follows:

Adrenalin hydrochloride 1:1000	4 c.c.
Adrenal cortical extract*	29 c.c.
Cortate	7½ c.c.

The patient needed no more suprarenal extract and his improvement was rapid. At present his blood pressure is 108/70, he is alert and happy, and has no abnormal neurologic findings.

Carey[2] reported a case of Waterhouse-Friderichsen syndrome with recovery in a 27-year-old woman using saline parenterally, epinephrine,

*The Upjohn Co., Kalamazoo, Mich.

adrenal cortical extract, antimeningococcic serum and sulfanilamide. One year later Sharkey,[8] in England, reported a similar case in a 40-year-old woman with recovery. She was treated with sulfapyridine, 4 to 6 pints of glucose-saline solution orally per day, and eucortone intramuscularly for several days. In 1943 Rucks and Hobson[6] mention having found a case reported by Bickel in Europe, but no details were given. They report the case of a 3-year-old treated with 5 per cent glucose in Hartmann's solution, blood transfusions, adrenal cortical extract, sulfathiazole, and vitamin K.

Williams,[9] in Australia, reports seventeen cases of fulminating meningococcemia with coma, collapse, and purpura. Autopsy in these patients revealed nine with bilateral adrenal hemorrhage and eight without. He therefore concludes that a clinical entity similar to the Waterhouse-Friderichsen syndrome can occur in fulminating meningococcemia. Gordon and Shimkin[3] report a case of fulminating meningococcemia with purpura and collapse in which the tentative diagnosis of Waterhouse-Friderichsen syndrome was made and the patient treated with adrenalin, adrenal extracts, saline, and sulfadiazine, but without success. At autopsy the pituitary was found to have areas of necrosis, but no definite change was seen in the adrenals.

In view of the above articles by Gordon and Shimkin[3] and by Williams,[9] a diagnosis of Waterhouse-Friderichsen syndrome is one that can be made with certainty at autopsy only. The fourth case reported in this paper, although having an identical clinical picture to the first three cases, cannot, therefore, be considered a proved case of Waterhouse-Friderichsen syndrome with recovery.

SUMMARY

1. Four cases of fulminating meningococcemia are reported. Three patients were found to have bilateral adrenal hemorrhage at autopsy. The fourth patient recovered with the use of adrenalin, adrenal cortical extract, cortate, saline, and sulfathiazole.

2. Other cases in the literature are mentioned in which the patients recovered and the treatment is listed.

3. Attention is brought to similar cases in the literature where autopsy failed to reveal the adrenal hemorrhages.

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THE SEDIMENTATION RATE AND WHITE BLOOD COUNT IN ACUTE POLIOMYELITIS

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THE diagnosis of acute poliomyelitis is at times most difficult to establish. This becomes especially true during epidemics when many cases are referred to contagious disease hospitals to rule out "suspect poliomyelitis" because of suspicious symptoms. Frequently the diagnostic acumen of the physician is taxed to the limit. He must rely upon every bit of evidence to substantiate or rule out the disease, and any consistent laboratory finding would be most helpful. In the hope of finding such an aid, we have investigated the sedimentation rate in poliomyelitis, which, to our surprise, we were not able to find in the literature.

Ninety-six cases of acute poliomyelitis were analyzed after the patients were admitted to the Contagious Disease Unit of the Los Angeles General Hospital. These patients entered during the first two months of the recent epidemic (May and June, 1943), and had proved, uncomplicated poliomyelitis. Sedimentation rates were determined on admission to the hospital, one week after admission, and two weeks following admission. In addition, white blood counts were determined at the time of admission. An analysis of the blood counts was believed to be pertinent in view of the discrepancy that exists in the various textbooks.

Technique.—The Wintrobe method for sedimentation rate determination was utilized.[1] Four cubic centimeters of blood drawn from the patient were oxalated with 0.4 c.c. of 2 per cent potassium oxalate and the sedimentation rate determined on this sample within two hours by a competent laboratory technician. The fall was determined at twenty-minute intervals for one hour, but in the final analysis that drop which occurred at the end of sixty minutes was the only rate used. This was correlated with the packed cell volume and the corrected sedimentation rate obtained from the usual Wintrobe chart.

A normal rate for females by this procedure is from 0 to 20 mm., while for males it is from 0 to 9 mm. Osgood and associates[2] determined the sedimentation rate in the various age groups using the Westergren method. These workers found that there was no essential difference in the age groups studied. In view of these findings, no attempt has been made to correlate age with the rate in this present study.

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Of the ninety-six patients with poliomyelitis, there were forty-four cases with paralysis of one or more extremities, thirty-two nonparalytic cases, and twenty bulbar cases. In the study there were fifty-five males and forty-one females. The age range was from 8 months to 33 years, with sixty-three patients 12 years or under, eighteen in their "teens," and fifteen between the ages of 20 and 33 years.

SEDIMENTATION RATES

In this group of ninety-six patients, sixty-three (65.6 per cent) had an increase of sedimentation in the first forty-eight hours. This increase ranged from 2 to 30 mm. above normal, with 80 per cent of the increase occurring within the range of from 1 to 13 mm. At the end of the first week, thirty-six (37.5 per cent) of these patients remained with increased rates, while at the end of their hospital stay only twenty-five (26 per cent) had sedimentation rates above normal. Of the thirty-three patients with normal rates on entrance, eight (24.2 per cent) developed abnormal rates at the end of one week.

Of the twenty with the bulbar type, sixteen had increased rates on admission. At the end of the first week, ten remained elevated, and at the end of the second week, only seven remained up. Of the four patients with normal rates on admission, two had an increase one week later.

Of the forty-four cases with one or more extremities in paralysis, twenty-six had an increased rate on admission. At the end of the first week, sixteen remained elevated, and at the end of the second week, only twelve remained up. Of the eighteen patients with normal rates on admission, three had an increase one week later.

Of the thirty-two with nonparalytic poliomyelitis, twenty-one had an increased rate on admission. At the end of the first week, ten remained elevated, and at the end of the second week, only six remained up. Of the eleven patients with normal rates on admission, three had an increase one week later.

The foregoing is summarized in Table I.

TABLE I

TYPE OF CASE	NO. OF PATIENTS IN GROUP	INCREASED IN FIRST FORTY-EIGHT HOURS	INCREASED ONE WEEK AFTER ADMISSION	INCREASED TWO WEEKS AFTER ADMISSION	NORMAL AT FIRST, THEN INCREASED
Bulbar	20	16 (80%)	10 (60%)	7 (35%)	2 of 4
Paralytic	44	26 (59%)	16 (36%)	12 (27%)	3 of 18
Nonparalytic	32	21 (66%)	10 (31%)	6 (19%)	3 of 11
Total	96	63 (66%)	36 (37%)	25 (26%)	8 of 33

Summary.—The Wintrobe sedimentation rate was determined in ninety-six patients with acute poliomyelitis. The majority of these (66 per cent) had an increased sedimentation rate on admission. In

80 per cent of these patients this rise was not marked, being only from 1 to 13 mm. above normal at the end of one hour. At the end of the first week, 37 per cent had an increased rate, and at the end of the second week, in only 26 per cent were there elevations. No appreciable difference was found in the sedimentation rates in patients with bulbar, paralytic, or nonparalytic poliomyelitis. One-fourth of the patients who had normal sedimentation rates on admission showed increase on subsequent weekly examinations.

WHITE BLOOD COUNTS

Ninety-three patients had a white blood count done at the time of admission. These counts were correlated with the range of normalcy for the patient's age. An increase up to 2,000 cells for the respective age was denoted as "slightly increased"; up to 6,000 cells increase, "moderately increased"; and above 6,000 cells, "markedly increased."

Of the ninety-three patients studied, fifty-eight had normal white blood counts (62 per cent), twenty-nine were increased (31 per cent), and 6 had leucopenia. Of the twenty-nine patients with leucocytosis, twenty-four (82 per cent) had only a "slight increase"; three, a "moderate increase"; and only two, a "marked increase." The highest white blood count was 22,000, while the lowest was 2,800. The white blood cells displayed a shift to the left except in those patients with nonparalytic poliomyelitis. Including those with leucopenia, sixty-five patients did not manifest a rise in the white blood count (69 per cent).

In breaking down the ninety-three cases studied, it was found that there were nineteen patients with bulbar involvement, forty-three with one or more extremities involved, and thirty-one who were nonparalytic.

Of the nineteen patients with the bulbar type, fourteen (72 per cent) had normal counts, while five were classified as having a slight increase. The highest count was 13,650, while the lowest was 5,800. The shift was definitely to the left.

Of the forty-three patients with paralysis of one or more extremities, twenty-five (58 per cent) were normal, seventeen (39 per cent) had a leucocytosis, and one had a leucopenia. The range of the white blood cells was from 3,800 to 22,000. The shift was again to the left. Of those patients with leucocytosis, the white blood cells in fourteen were slightly increased; in two, moderately increased; and in one, markedly increased.

On the thirty-one patients with nonparalytic poliomyelitis, nineteen (61 per cent) had normal counts, seven (22 per cent) had a leucocytosis, and five had a leucopenia. The range was from 2,800 to 19,750. The shift was not remarkable in this group. Of those with leucocytosis, the white blood cells in five were slightly increased; in one, moderately increased; and in one, markedly increased.

Fig. 1 illustrates the trend of the blood count in these 93 patients.

Summary of Blood Counts.—The white blood count was determined in ninety-three patients with acute poliomyelitis. The majority of the counts (70 per cent) were either normal or low. Two patients had marked leucocytosis, and only five had counts of 16,000 or above. The white blood count varied from 2,800 to 22,000. No appreciable difference was found in the blood counts of patients with bulbar, paralytic, or nonparalytic poliomyelitis.

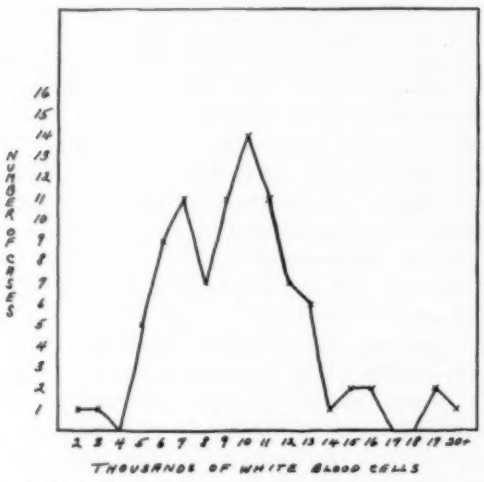

Fig. 1.—Distribution of white blood counts in poliomyelitis.

COMMENT

In reviewing the sedimentation rates of these ninety-six patients, it is apparent that this simple test falls far short of being a pathognomonic approach to the diagnosis of poliomyelitis. The belief of some clinicians, that in poliomyelitis there is a normal rate, must be considered erroneous in the light of the present findings.

The determination of the sedimentation rate may prove to be of value, however, in the differential diagnosis of poliomyelitis and rheumatic fever. Whereas in rheumatic disease the increase is usually quite marked and remains so over a period of weeks, in poliomyelitis the increase is usually not great and in approximately three-fourths of the patients the rate will return to normal within two weeks. This is further corroborated by the behavior of the white blood count, for in rheumatic disease the majority of patients have a leucocytosis, while in poliomyelitis the majority have normal or low blood counts.

CONCLUSION

There is a marked variability in the sedimentation rate and white blood count in acute poliomyelitis. Although these tests are not diag-

nostic, they may present a clue to the diagnosis of the disease; namely, white blood counts above 16,000 and sedimentation falls in excess of 13 mm. above normal (Wintrobe) are uncommon.

In the differential diagnosis of poliomyelitis and rheumatic fever, the determination of the sedimentation rate and white blood count may prove to be of value.

In the individual case of acute poliomyelitis there is no correlation between the severity of the disease and the sedimentation rate or white blood count.

We are indebted to Miss Wilma Funk, Certified Laboratory Technician, for determining the sedimentation rates in this study.

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THE ROLE OF THE SURGICAL MASK IN THE PREVENTION OF CROSS-INFECTIONS IN HOSPITAL NURSERIES FOR NEWBORN INFANTS

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DURING the past decade, the New York City Department of Health has been actively engaged in the study of the problem of communicable diseases affecting newborn infants who are cared for in the nurseries of maternity hospitals. Interest in this important problem began with the occurrence of the initial outbreak of epidemic diarrhea of the newborn infant in this city.[1] Not only were the diarrheal disorders of the newborn infant made the subject of intensive study, but soon investigations were extended to include all communicable diseases peculiar to the neonatal period, such as impetigo contagiosa neonatorum, the respiratory disorders, and thrush. The studies revealed the marked susceptibility of newborn infants to these disorders. Observations further emphasized the rapidity of spread of infection from baby to baby once contamination was introduced into the nursery and the difficulty with which such infection was controlled and eradicated.

In order to combat these highly communicable diseases, the Sanitary Code of the City of New York was amended in December, 1937, to include Section 110.[2] This section laid down broad rules and regulations for the conduct of lying-in institutions and nurseries for newborn infants. For the first time in the history of public health administration, the amendment placed maternity hospitals under direct municipal supervision. The rules and regulations were adopted by the Board of Health only after their details were carefully studied as to theoretical background and practicability by a special committee consisting of members of the five County Medical Societies, the New York Academy of Medicine, and other interested public health authorities.

The activities of maternity services were completely divorced from those of all other services in the hospitals. Standards were adopted for the physical arrangement of lying-in services with the separation of "clean" maternity patients and their babies from those frankly infected and those potentially infected. Likewise, physical barriers were erected in the prevention of the spread of infection, particularly in nurseries, and minimal equipment specified. In addition, the well-recognized techniques of aseptic nursing care, patterned after the principles of surgical asepsis, were incorporated to establish further im-

Read at a Joint Meeting of the Special Committee of Infant Mortality, Dr. Bret Ratner, Chairman, and the Committee of Child Welfare, Dr. Leslie O. Ashton, Chairman, Medical Society of the County of New York, April, 28, 1943.

portant safeguards for mothers and babies in lying-in hospitals. Among the details of nursing care of the babies, masking of the nose and mouth was made mandatory for all individuals during their stay in the nurseries. No stipulations were laid down, however, as to the type of mask to be worn, the selection being left to the discretion of the individual hospital.

THE SURGICAL MASK

The history of the use of surgical face masks has been characterized by considerable controversy concerning their efficiency in the prevention of infection. Every few years the dispute is renewed. First introduced in the surgical operating room, the masks were later adapted for service by the personnel in medical and pediatric wards and in nurseries for newborn infants as one of the techniques in the prevention of respiratory diseases.

While surgeons are generally agreed as to the necessity for adequate masking in the operating room, medical men are still not fully in accord as to the role played by masks in the control of cross-infection in wards and in nurseries. Recently there has again been some agitation to discard the use of masks by the personnel in nurseries for newborn infants. It is claimed that they are of limited efficiency, that they are too time consuming in a baby nursery, and too uncomfortable and hot to wear properly several hours each day. It is also stated that the expense of supplying and laundering the large number of masks required is out of reasonable proportion to the benefits derived from them.

TYPES OF SURGICAL MASKS

In view of these objections, it would seem worth while to review the entire situation with respect to the efficiency of the surgical mask in the prevention of cross-infection in nurseries for newborn infants. Perhaps a study of the literature might shed some light on the problem. At the outset it should be borne in mind that many types of masks are now in use, each of varying construction and each differing in principle. In studies of the efficiency of surgical masks, it is therefore of importance to specify the type employed as well as its fabrication.

The Filtering Mask.—Basically, three types of surgical masks are in general use. One form is the filtering mask which is made from a porous material, such as gauze mesh, of various thicknesses and folds. This type permits breathing through the mask and traps the larger respiratory droplets forcibly exhaled through the nose and mouth during speaking, sneezing, and coughing. Some absorption of the droplets may be present. However, by reason of their construction, the finer respiratory droplets are filtered through, and leakage also occurs beneath the edges of the masks.

Various forms of filtering masks have been devised, ranging from the simple two-fold sheer gauze mask to those of heavier fabrication. In

1918 Weaver[3] and Capps[4] described their mask made from 40 by 40 gauze mesh in three-ply fold with three pleats. Weaver reported a reduction in the incidence of carriers among the personnel in diphtheria wards from 23.5 to 8.2 per cent, the only change in nursing technique having been the use of his mask. Capps claimed a reduction of 95 per cent in scarlet fever and 100 per cent in cross-infection from measles by the use of Weaver's mask. In 1918 Doust and Lyons[5] stated that masks of from two to 10 layers of coarse and medium gauze were ineffective, but that one fabricated from three layers of butter cloth, a very fine mesh gauze, gave perfect results. In 1927 Meleney[6] showed that the adequate use of gauze masks, the type not being described, caused a marked reduction of postoperative *Streptococcus hemolyticus* wound infections which had been recurrently appearing during the late winter and spring months on his surgical service. Kellogg and MacMillan[7] demonstrated that the efficiency of gauze masks depended upon the number of layers used in their construction and on the fineness of the gauze mesh. These investigators believed that the effectiveness of gauze masks seldom exceeded 50 per cent, since beyond a certain number of layers of gauze, the masks become too uncomfortable for the wearer. Recently, Robertson, Doyle, and Tisdall[8] described a filtering nose and mouth screen constructed from one layer of fine flannelet. In passing, mention should also be made of the coarse paper masks which are of limited efficiency and are designed for but brief use.

Filtering and Absorbing Masks.—The second type of mask employed is the filtering and absorbing mask such as that devised by McKhann and his co-workers.[9] This nose and mouth screen, through which the wearer breathes, consists of two layers of gauze separated by a thin layer of compressed cotton filler. The efficiency of this mask depends upon the absorbing qualities of the cotton layer in trapping respiratory droplets. McKhann believes that this mask is a considerable improvement over the ordinary gauze screen.

Deflector Masks.—The third variety of mask is the deflector type fabricated from a transparent, impermeable, lightweight substance such as cellophane. With this mask, inspired air enters from about the wearer's chin, and expelled air is deflected back toward the cheeks and ears. These impervious screens of the type devised by Davis[10] and by Waters[11] prevent direct expulsion of large droplets but do not protect against the deflected finer respiratory droplets leaking past the edges of the masks. Another type of impervious mask is that constructed from wax paper by Mellinger.[12] This mask is supported at its upper edge by copper wire. However, since it is unattached at the bottom, the mask waves freely in the air with each expiration and falls away from the face as the wearer leans forward. Its efficiency is therefore very limited.

Other Types of Masks.—Attempts have also been made to construct efficient masks by combining the principles both of the filtering and of the deflector screens. The mask of Blatt and Dale[13] consists of two

layers of gauze with an intervening layer of cellophane. Walker[14] designed a nose and mouth screen by inserting in a central position between two layers of gauze, each ten inches square, a six-inch square of rubber salvaged from discarded gloves.

AIR-BORNE INFECTION

At this point it would seem timely to discuss briefly the mode of transmission of air-borne infection and to inquire into the function of the surgical mask in the prevention of its spread. According to Wells and Wells,[15] respiratory droplets expelled into the air from the nose and mouth during speaking, coughing, and sneezing do not immediately fall to the ground. Immediate evaporation takes place, and as the droplets become smaller, they fall slower and slower with the lessening of gravitational pull. Eventually evaporation occurs to a size of 0.1 mm. in diameter or less, at which size the dried droplets remain suspended in the atmosphere, acting like smoke and drifting or floating with the air currents.

Transmission of infection through air, Wells and Wells[15] have shown, may then occur in one or two forms, depending on the size of the droplets. The first is droplet infection by droplets larger than 0.1 mm. in diameter, the droplets of Flugge.[16] These are rapidly removed from the air within a short distance from the source before drying. The second form is air-borne infection proper and is related to the suspended dried residues of infected droplets; that is, the droplet nuclei. These are derived from droplets less than 0.1 mm. in diameter. They remain suspended in air for longer periods and are borne longer distances. After settling and evaporating, the droplets of Flugge may also convey air-borne infection when lifted into the air as dust. Droplet infection is basically localized and concentrated, while droplet nuclei are more widely disseminated and dilute, hence capable of spreading infection more widely.

In the prevention of infection, it is therefore the function of the surgical mask to act as a primary barrier in trapping and absorbing infected droplets at their source. Thus the dissemination of large droplets and consequently the excessive formation of droplet nuclei in the atmosphere are prevented. According to McKhann and his co-workers,[9] the literature shows that the surgical mask is about 50 to 75 per cent effective in stopping cross-infection, depending of course, upon the type of mask used. It is generally agreed that the ordinary one- or two-ply sheer gauze mask and screens made from paper are of limited effectiveness. The efficiency of masks increases with the use of absorbent and more closely woven or impervious fabrics and with the snugness of fit to the nose and mouth to prevent leakage. Walker[14] has advanced minimal standards for efficient nose and mouth screens. They should not permit the passage of droplets, when dry or moist, during conversation. They should also

completely cover the nose and mouth and allow of prolonged comfortable application without becoming unduly warm. Fogging of eyeglass lenses should be avoided.

PRACTICAL APPLICATION

A discussion of the efficiency of the surgical mask in the prevention of infection under conditions inherent in nurseries for newborn infants is next in order. On reviewing the literature, one is surprised that no studies have been recorded dealing primarily with the effectiveness of masks in preventing respiratory infections among the highly susceptible newborn infants in the nurseries of lying-in hospitals. The reports[8, 9, 17-20] which have been published concern pediatric wards for older infants and children. In addition, these studies were not basically designed to test the efficiency of masks in which all other factors were maintained constant. On the contrary, the investigations inquired into the practicability of such armamentarium as ultraviolet irradiation, air conditioning, and propylene glycol vaporization in the prevention of cross-infection in pediatric wards and in nurseries for premature infants. The effect of barrier cubicles and the value of aseptic nursing care were also studied.

From the point of view of spread of infection, marked differences exist between pediatric wards and nurseries for newborn infants. In pediatric wards, children of all ages are admitted for many varieties of infections and conditions. Once admitted, these children remain a stationary population for a variable period in the wards or nurseries to which they are assigned. Only occasionally are they transported for roentgenologic studies and for therapeutic procedures. Thus in devising mechanical contrivances for the control of infection and in carrying out techniques of aseptic nursing care, attention need in the main be focused on the wards and nurseries proper. In addition, the personnel and physicians attending a pediatric service are comparatively limited in number.

Quite a different picture exists in nursery services for newborn infants. It is of importance to bear in mind that the present-day dormitory nurseries are designed to contain healthy infants, not sick infants. The population in these nurseries is furthermore far from stationary. There is a continued turnover of new admissions and discharges, the period of stay averaging about ten days. In addition, there is the frequent transportation for nursing and display of babies from the nursery through public corridors to the mothers' wards and rooms and back again. This movement occurs up to ten times a day on any maternity service. The chance of exposure to infection is therefore greatly multiplied. Likewise, there is an added traffic on a maternity service made up of the ever-changing personnel, the regular attending medical staff, and the host of courtesy physicians, not to mention the curious and careless visitors. It is indeed remarkable that the highly susceptible newborn infant who is thrown into this seething mass of activity ever survives the first two weeks of life.

It would seem, therefore, that if, in the prevention of infection among newborn infants in lying-in hospitals, main reliance were to be placed on mechanical devices such as air conditioning, ultraviolet irradiation, and propylene glycol vaporization, these measures must necessarily be extended to include the public corridors and spaces occupied by the mothers. As has been emphasized by McKhann,[9] no mechanical measure alone can be relied upon to prevent infection in hospital wards and nurseries. If this situation holds true for the static population on pediatric wards, then it applies with even greater force to the constantly moving population on newborn services. The erection of physical barriers will not in themselves prevent the spread of infection among newborn infants in nurseries. Of equal importance are the well-recognized measures of aseptic nursing care, the one supplementing the other. A chain is only as strong as its weakest link. In this instance the weakest link is the human fallibility of the nursing personnel and the attending medical staff on the maternity service. To these individuals must be added the mothers and visitors unwittingly carrying infection to the newborn infant. Any recognized measure of preventive medicine applied to these groups of persons in a limited space is distinctly indicated in all phases of activity on a maternity service.

The use of the surgical mask in the control of droplet infection is an important integral part of preventive nursing and medical care, even though it is believed that the mask has an efficiency only of from 50 to 75 per cent.[9] The oft-heard criticisms of expense, difficulty in supplying and laundering the masks, and tediousness of application are not valid arguments when reckoned in terms of protecting the lives of babies. Far from abandoning the surgical mask, efforts should be directed toward its improvement, and the wearers should be carefully instructed as to its more efficient use. The use of the ordinary sheer gauze mask and of the paper mask should be eliminated in favor of those of more adequate construction, such as the absorbing or the deflector variety. In the meantime, well-controlled studies are needed to determine the true efficiency of the various masks when used under the unique conditions in maternity hospitals.

SUMMARY

At recurrent intervals, criticisms are made questioning the utility of the surgical mask in the prevention of droplet infection in hospital wards and in nurseries. The problem has recently flared anew, this time with regard to the use of the surgical mask as a part of the prescribed technique of aseptic nursing care of newborn infants in the nurseries of maternity institutions.

In order to shed light on this aspect of the subject, the literature was searched, and, surprisingly enough, no reports were found having a direct bearing on the problem as affecting nurseries for newborn infants. Considerable work has been done dealing with the control of cross-

infection in hospital pediatric wards. Even in these investigations, however, the efficiency of the surgical mask has been the subject of only incidental study. No valid conclusions can be drawn, therefore, as to the effectiveness of the surgical mask under the novel conditions on active lying-in services. It must be stressed that marked differences exist in the conduct of pediatric services and nursery services for newborn infants.

Adequate studies are needed, therefore, to determine the function and efficiency of the various types of surgical masks in the prevention of respiratory infection among newborn infants receiving hospital care. Until such investigations can be carried out, the more effective absorbing or deflector masks should be used as an integral part of the aseptic nursery care of newborn infants. Efforts should be made to improve upon the construction of the mask to act more adequately as a primary barrier in the prevention of air-borne infection.

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MEDICAL SOCIAL WORK IN AN EPIDEMIC OF POLIOMYELITIS

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DURING the summer of 1943, southern Connecticut experienced an epidemic of poliomyelitis of large proportions which, because of number of victims, family reactions, and community fear had much in common with disaster problems. Most of the patients were cared for at New Haven Hospital. In trying to help families of patients to meet this emergency the medical social worker found there were certain recurring reactions of the families toward the illness and its results. In adapting and working under pressure, some of the techniques of the medical social worker were modified. The emergency required the development and adaptation of community resources, and the whole episode was both colored and accompanied by the apprehensions of the community. Therefore, this paper will cover the medical social aspects of the diagnosis of poliomyelitis and especially the reactions of the children, adult patients, and their families to some of the specific problems created by epidemic conditions. We have been unable to find any literature dealing with the particular aspects to be included in this article.

This is the first of two papers. The second will follow the same group of patients through the long process of readjustment to convalescence, possible limitation of activity, and emotional strains to which the ill person is subjected in daily living with his family, in school, and with his social group.

Course of the Epidemic.—The first two patients were admitted on June 19. From then until the peak was reached on August 19 there was a slow but gradual increase in the number of patients admitted each week. On August 7 there were forty-three patients, on August 9 there were fifty-two, and on August 19, ninety-two, which was the peak in the hospital at any one time. After August 19 there was a very gradual decline until November 1 when only seven patients with poliomyelitis were left in the hospital. During this period, June to November, 204 cases had been treated at New Haven Hospital. This study covers 172 of these patients since the abortive cases and those patients who died were not included. The following are some interesting statistics showing the composition of this group.

Aided by a Grant from The National Foundation for Infantile Paralysis, Inc.

Comparison of Total Cases of Poliomyelitis to General Population.—Approximately one out of every 1,100 persons in the area covered developed poliomyelitis. Approximately one out of every 1,500 persons in the City of New Haven developed poliomyelitis.

Age and Sex Distribution.—See Tables I and II.

TABLE I

AGE AND SEX DISTRIBUTION (YEARS)

AGE		SEX	
YEARS	TOTAL	MALE	FEMALE
0 to 1	1	1	0
1	11	6	5
2	21	10	11
3	11	8	3
4	12	5	7
5	14	8	6
6	9	2	7
7	11	6	5
8	9	8	1
9	8	5	3
10	12	9	3
11	7	4	3
12	9	8	1
13	4	0	4
14	7	7	0
15	12	6	6
16	3	2	1
17	1	1	0
18	0	0	0
19	0	0	0
20 to 30	6	0	6
30 to 33	4	2	2
Total	172	98	74

The youngest child was 7 months old and the oldest adult, a man, 33 years old. There were more children 2 years of age than in any other age group (Table I). Eighty-five per cent of these patients

TABLE II

AGE AND SEX DISTRIBUTION (AGE GROUPS)

AGE GROUP (YR.)	TOTAL	MALE	FEMALE
0 to 1	1	1	0
1 to 4	55	29	26
5 to 9	51	29	22
10 to 14	39	28	11
15 to 19	16	9	7
20 to 30	6	0	6
30 to 33	4	2	2
Total	172	98	74

were between the ages of 1 to 15 years, 9 per cent between 15 and 19 years, and 6 per cent between 20 and 33 years.

It is interesting to note that four-fifths of the patients between 20 and 33 years were females. In all other age groups the males exceeded the females.

Color.—All patients were white except two Negro children, residents of New Haven. In proportion to total Negro population this was about one to every 3,000 Negroes in the City of New Haven. There are few Negroes in the area outside of New Haven served by the New Haven Hospital in this epidemic.

Religion.—

54% were Catholic
33% were Protestant
5% were Jewish
8% were unknown

In the general population of New Haven 57 per cent were Catholic, 29 per cent Protestant, and 12 per cent Jewish, so that this group followed fairly closely with the general trend.*

Racial Stock.—

67% had American-born parents
22% had foreign-born parents representing various European countries
8% had Italian-born parents, 18% Italian-born grandparents
3% unknown

In the general population about 37 per cent are native-born of Italian parentage.*

Size of Family.—

76% were in families of from one to three children.

Economic Condition.—

1. Income

61% had incomes over $30 and under $65 a week with the largest group $35 to $50
20% not known
Lowest income was $20 for a family of 3
Highest income was $125 for a family of 5

The average wage for unskilled labor for a forty-eight-hour working week in the New Haven area at this time is between $31.20 and $40.56 a week. Thus it appears that the income level of the group studied was slightly higher than that of the unskilled laborer.

2. Rentals

74% paid $15 to $40 per month
Over 50% paid $20 to $30 per month, a low rental for the community as a whole
20% unknown

*Dreis, Thelma A.: Handbook of Social Statistics of New Haven, Published by Yale University Press for Institute of Human Relations, 1936.

3. Debts

a. Medical debts

21% had medical debts ranging from a few dollars to $500
57% had no medical debts
22% not known

b. Other debts

33% had debts from a small amount to $700
44% had no other debts
23% not known

4. Savings

45% had savings from $500 to $3,000
47% had no savings
8% not known

Size of savings was greatly augmented by purchase of War Bonds in many instances up to 10% of earnings.

5. Insurance

48% had hospital insurance
71% had general life insurance

Employment of Wage Earners in Families Studied.—

61% were laborers
33% were white collar workers
5% were supported by public or private relief agencies
1% were in the professional group

Families Known to Community Health and Welfare Agencies.—The Social Service Index is an index to confidential information about families previously known to social agencies. It is used by all social agencies to discover both current and past agency interest thus avoiding duplication of service and fostering cooperative work between agencies. Fifty-two per cent of the one hundred sixty-four cases cleared with the Social Service Index had been known to social agencies, and there was no registration on 48 per cent. Nineteen per cent were known to case work agencies such as Family Society, Medical Social Service, Catholic Social Service Bureau, Red Cross Home Service, Children's Center, Bureau of Child Welfare, and Jewish Family Service, while 52 per cent of the eighty-one families about whom there was social information had registrations with local relief agencies. Eight per cent had been known to Psychiatric Out-Patient Clinic and 59 per cent had been followed by the Visiting Nurse Association.

Thus it appears that almost one-half of the families were self-maintaining and in addition had never used case work or relief agencies. Slightly more of the group had used a nursing service than had been on direct relief. Only 4 per cent of the entire group studied had, to our knowledge, used psychiatric resources.

Summarization of Statistics.—This material about patients with a diagnosis of poliomyelitis indicates that the disease is one of childhood. Religious background is not significant except that there are fewer Jewish patients than one would expect in relation to the general population of the City of New Haven. Statistics about racial stock reflect the preponderance of an Italian racial strain in the general population.

Socioeconomic background of the typical patient in this group points up a family of one to three children, the father a laborer and less frequently a white collar worker. If the father were a laborer, he earned the average factory wage or slightly more.

Income and rent definitely fall in a lower middle class grouping. A quarter of the number had medical debts which were burdensome and out of keeping with earnings. Over one-half of the group had attempted to budget for illness by participation in group insurance plans to lessen the cost of acute illness.

One-half of the group were living within their incomes, but considerably over a fourth of the families had debts out of scale with earnings. One-half of the families showed a desire to safeguard the future by accumulating savings and over three-fourths of the group had invested in general life insurance.

It is the writer's opinion that both the incomes and savings of the group have increased markedly during the war period because of high paying defense jobs and because of the purchase of war bonds.

Slightly less than one-half of the families had not been to social agencies, indicating a certain degree of adequacy and self-sufficiency. Of the families known to social agencies one-fourth had been on relief and one-fifth had had case work service previously.

Community Reactions.—Apprehension accompanied the spread of the epidemic. Probably because of the scattered location of cases, the rapid increase in number of patients, and the lack of knowledge as to the cause and how to avoid the disease, reactions of fear broke out. People crossed the street to avoid passing directly in front of the house of a victim. One family in quarantine could not use an outside, separate, upper porch because of hostile remarks from the neighbors. Parents, following the quarantine period, found it best to cancel social engagements, even in homes where there were no children. One of the Catholic churches had services outdoors. Families away for the summer stayed longer to protect their children. Whether the schools should open on time was debated in many communities and in New Haven they opened two weeks later than originally planned.

Much interest was felt in the Kenny method as written up in the *Reader's Digest* and other popular magazines. In general, people were convinced it was an absolute cure. Rumors, mostly based on misinformation, were rife. Newspaper publicity fanned the fire. Write-ups

of the Kenny method, newspaper predictions about the epidemic, the number of new cases, and the large number of patients discharged directly home from the hospital rather than to convalescent homes created false optimism. In short, the community was constantly reacting to every type of information available about poliomyelitis and the epidemic was the common topic of conversation.

Special Problems in a Wartime Epidemic.—The isolation wards of the New Haven Hospital are the community resource normally in use for the county for patients needing isolation. These wards are usually adequate to care for the number of cases needing isolation. Fearing future poliomyelitis epidemics and in an effort to plan for future needs, in 1941 the New Haven County Chapter of the National Foundation for Infantile Paralysis and hospital administrators had arranged for an unused hospital to be reopened should there be need. However, the Army leased this hospital after the outbreak of war, and therefore it was no longer available at the time of the present epidemic. In addition, both medical and nursing staffs had been reduced, as personnel had been diverted from civilian to direct war service in the United States or overseas. As New Haven is teeming with war industry, erstwhile porters, ward maids, and unskilled labor flocked toward high-paying defense work, leaving the hospital incompletely staffed. The Kenny treatment was another complicating factor with its need for almost constant care of the patient and the increased personnel needed to give this care.

How to give this large number of patients adequate medical and nursing supervision became a vital issue. Within the hospital the staff was readjusted. On the children's isolation ward, with a usual ward census of twenty-eight to thirty-three patients, there were at the peak of the epidemic three general pediatric isolation cases and ninety-two patients with poliomyelitis. The staff of interns was gradually increased from two to four and the staff of assistant residents was increased from two to three. A full-time orthopedic physician was assigned to the patients with poliomyelitis. Two floors of the Isolation Building were entirely taken over by patients with poliomyelitis and the third almost completely.

Nurses from the New Haven Department of Health, Visiting Nurse Association, Crippled Children's Division of the State Department of Health, Crippled Children's Aid Society of New Haven, and nurses from surrounding areas responded for limited periods of service to a local appeal of the Department of Health. The time of one and one-half physiotherapists was assigned to meet the needs of hospital cases.

To deal with the behavior problems which arose a close-working relationship was established with the psychiatric consultant in the Department of Pediatrics. The doctor and medical social worker were

free to discuss potential problems with the psychiatrist in order to secure psychiatric guidance in their own work with families. The psychiatrist gave a substantial amount of time to interviewing particularly disturbed children or their families. Thus the doctors and medical social workers were helped to evaluate the degree to which certain reactions were normal or abnormal in relation to acute illness.

It was obvious that patients on complete bed rest but able to move actively in bed would need planned diversion of some sort. Wringing packs and feeding the children did not require nursing skills but did take time from nursing duties. Volunteers were trained to meet these needs. Also, they procured radios and read to the patients. Patients dictated messages to their families, which the volunteers transcribed on post cards, thus maintaining contact between patient and family during the period in isolation. The boys were organized into "Marine" units and the girls became "Waves" to help to keep up morale and discipline. A weekly newspaper with contributions by the children was published through the interest of volunteers. By keeping the children occupied, their adjustment to the hospital regime was facilitated and the time of busy nurses was saved for more emergent service to patients.

With the limited number of physicians available, the only solution seemed to be to use the doctors for the immediate, emergent needs of the patients, and to delegate to the medical social worker the responsibility for giving the diagnosis and interpretation of the treatment to the families, referring doctors, social agencies, and other personnel within the hospital.

During this epidemic families seemed to need a chance to talk with a person who was calm and objective in working through intense and highly emotional situations. The hospital is a maze of complicated specialized departments and avoidance of additional confusion for already upset people was desirable. In addition, a knowledge of community resources and an ability to work appropriately and easily with community agencies were indicated. The medical social worker seemed unusually well fitted for this emergency assignment when some substitute for the doctor was needed. The core of her training is individualization of people in distress. With this method it could be hoped that the family could be helped to reach an independent decision which would be followed by appropriate, necessary action and relief from pent-up anxiety. Because of the techniques of interviewing which the medical social worker is constantly using, she is sensitive to feelings and can be helpful in individualizing the family and the reasons for the emotional upset.

Dr. Joseph I. Linde, Chairman of the New Haven County Chapter of the National Foundation for Infantile Paralysis and Health Officer of the City of New Haven, considered the financial predicament facing families when long-time hospital and convalescent care was advised

because of a diagnosis of poliomyelitis. Some person available at the hospital and able to work out an individual plan based on the different needs of each family was needed to make definite financial recommendations to the Foundation. A common denominator was needed to distribute funds fairly. Medical Social Service was requested to interview each family to interpret the Foundation and what it could offer in this emergency. After social study and upon recommendation of the medical social worker, the Foundation agreed to give financial help both for hospital and convalescent care. Accordingly the pediatric worker was assigned to patients with poliomyelitis, until, due to the number of patients in mid-August, two other social workers were transferred from other services in the hospital and added to serve the patients with poliomyelitis. Thus, three workers gave almost full time to these patients. In so far as possible, the same worker carried through with each family assigned to her.

Community Planning.—The development of a coordinated plan for the best care of the patient shows that the normal sphere of influence of the medical social worker extends beyond the hospital walls into the community. It became apparent in the process of providing adequate home care of patients with abortive poliomyelitis who were still on isolation precautions, that some uniform type of instruction in isolation precautions for the home should be developed. The Board of Health, Visiting Nurse Association, and Crippled Children's Aid Society were the already existing resources used for this purpose.

The Department of Health of the City of New Haven is equipped to give many services in relation to communicable diseases. It is the responsibility of this department to make home visits to interpret isolation precautions as soon as the diagnosis is made and reported. The Crippled Children's Aid Society is a private agency which provides nursing follow-up in the homes for patients needing orthopedic supervision. There are two orthopedic nurses on the staff. The Visiting Nurse Association provides general nursing care for communicable and noncommunicable disease. This Association planned to lend nurses to the Crippled Children's Aid Society and to share with the latter agency the supervision of patients at home with poliomyelitis if the number of patients exceeded that which the nurses of the Crippled Children's Aid Society could serve according to the standards set.

It seemed wise to pool information and correlate functions of all for the maximum service to the patient. A conference was called by Medical Social Service to clarify the isolation precautions in the workers' minds and to settle the area of function of the Department of Health, Visiting Nurse Association, and Crippled Children's Aid Society. It became clear as a result of this meeting that certain duplications in service existed and as a result of this conference written isolation instructions were given to the families when the Department of Health

nurse visited the homes after admission to the hospital and at the time the patient left the ward. The two Department of Health nurses, already overworked, were later relieved of the necessity to visit to give instructions after discharge. Instead, the Crippled Children's Aid Society agreed to supervise care in the home and provide transportation to clinic. Medical Social Service was to determine whether the home was suitable for care and a home visit was frequently made at this time to discuss practical points with the families. Medical Social Service was to keep the nurse of the Crippled Children's Aid Society informed of discharge dates and recommendations on each patient having care at home. Thus the available resources were used according to the needs presented and according to their appropriate function.

The decision as to what resources could be used for convalescent care was made by Dr. Joseph I. Linde, Chairman, New Haven County Chapter, National Foundation for Infantile Paralysis, Dr. Grover F. Powers, Chief of the Pediatric Staff at the New Haven Hospital, and by other executives and administrators within the hospital according to medical standards and the needs of the children for care. Medical Social Service worked out the details of each individual use of these resources, including interpretation of the plan to the child and his family, financial arrangements for convalescent care, transfer arrangements, and interagency planning.

It was the usual procedure that the doctors telephoned the referring physicians previous to discharge in order to explain the findings and to secure approval of the plan for discharge, but in this time of emergency, the medical social worker was asked by the medical staff to assume this function. Each referring physician was telephoned, if possible, before the patient's discharge, to explain briefly the patient's condition, the proposed plan for care, the possibility of orthopedic follow-up at the hospital and the conditions within the hospital which made it necessary for the doctors in the hospital to pass information to the referring doctors through the medical social worker in the hospital. The workers felt that the referring doctors were most understanding of the situation, and, that once they had been informed of the plans, were most helpful in explaining and reinforcing the hospital's suggestions for the patient's care.

The only real difficulty faced by the workers in this relationship with outside physicians was when the referring doctors explained to the family that the patient was a "mild case" and "would be home soon." This undoubtedly was done in order to meet the family's need for specific help about the patient's condition from a doctor and reflects the difficulties faced by the physicians who were unable to reach the doctors in the hospital, although they could read the patient's record on the ward. Unfortunately in some cases this type of explanation given by

the referring physician made it difficult for the family to accept the extent of the patient's illness and the need for convalescent care away from home.

Method.—When the patient was admitted, the doctor discussed with a member of the family the patient's condition, the usual treatment plan during the acute period of three weeks, the method of securing daily reports from the hospital operator and advised that the medical social worker would consult with them about financial and other plans for the patient since it would not be possible for the doctor to see the families again until discharge because of the tremendous pressure and need to devote their time to the patients.

Each day the admitting office notified Medical Social Service of admissions so that every patient with poliomyelitis was referred. In a daily conference with the medical social worker the Pediatric Resident confirmed diagnoses, gave some medical interpretation, explained the pressures on the ward, and the future medical needs of the children for convalescent care. At this time the social workers and resident pediatrician planned jointly for the patients. Following this the social workers conferred with each other to be sure that the same content of information was being given to families and to discuss special problems and policies.

Families were reached by telephone so that within as short a time as possible after the establishment of the diagnosis, they could be aware of the service offered by the medical social worker. She explained that the doctor had asked her to talk with each family about the patient and also to discuss the available resource of the National Foundation for Infantile Paralysis. In most instances there was an eager response and an appointment was made for the same day or as soon after as the family could come and the social worker's crowded schedule would permit.

At first the doctors felt that the patients would need hospitalization for a period of six weeks to six months. Therefore the procedures followed the first three weeks by the social worker varied slightly from the plan finally worked out. Later, because it was impossible to give continued care after the acute period to the large number of patients already admitted as well as to provide intensive care for new patients, the need for suitable convalescent centers was discussed. Newington Home for Crippled Children and the Children's Community Center agreed to provide the care needed. Workable plans of transfer were arrived at through consultation between the cooperating social service departments. These agencies agreed to take the patient after the three weeks of isolation and when the patient was convalescent and no longer in need of the diagnostic or treatment services of a hospital for the acutely ill. In those cases in which prostigmine was given, the patient

went to the Children's Center. Otherwise the worker made the decision as to which resource to use according to the family situation and more often on the basis of where a bed was available.

The Children's Center.—The Children's Center, a private social agency built on the cottage plan and ideally situated, staffed, and equipped, provides case work service in child placing, adoption, boarding, and convalescent care for New Haven County. (Only occasional service for out of county cases is given.) The Center was the logical place to turn for assistance with convalescent care, but was so limited in number of beds that a supplementary resource was necessary. The convalescent cottage of the Children's Center is staffed with a resident physician, nurses, attendants, Kenny physiotherapists, an occupational therapist, a schoolteacher, and a medical social worker. The weekly rate is $17.50. The bed capacity of the convalescent cottage is sufficient for forty patients. The Center agreed to accept thirty patients with poliomyelitis, discharging other patients to meet the emergency. There is a close-working relationship between Medical Social Service at the New Haven Hospital and the Children's Center, as plans for convalescent care for general pediatric cases are frequently carried out through the medical social worker at the Center. Working policies and agreements had long since been established and were continued with these patients. As was the usual custom, Medical Social Service transferred case work responsibility to the Children's Center at the time of the patient's discharge from the hospital to the Center. At this time as complete a social study as had been obtained was sent by the medical social worker at the Hospital. This contained at least a description of the family's feelings, anxieties, reactions, the child's adjustment to the hospital, and the financial plan. At the time of discharge from the Children's Center the patient would usually be referred back to the New Haven Hospital clinics and the hospital worker would review and carry the responsibility if further social treatment was indicated.

It was arranged that the orthopedic staff of New Haven Hospital would make rounds at the Center weekly to visit the children with poliomyelitis. Prostigmine therapy would be continued there.

Visiting hours at the Center at first were for an hour once a week, but were gradually increased to three times weekly.

A total of thirty-four patients were discharged from the Hospital to the Children's Center.

Newington Home for Crippled Children.—Newington Home for Crippled Children, thirty-seven miles from New Haven, is the only institution for crippled children in the State of Connecticut and takes children from any section of the State. Its principal function is the orthopedic and neuro-orthopedic care of children from 9 months through 18 years of age, and provides surgical as well as convalescent care. The main hospital building is a brick, residential structure set

on a hill and surrounded by grass and gardens. Mainly bone and muscle handicaps are treated in the sixty-bed hospital. Many of the children are bedridden for months or years and one is acutely aware of crutches, limps, and deformities. Many children with neurological disorders are unable to talk or use their hands. Orthopedic specialists from Hartford make rounds regularly. The medical, nursing, physiotherapy, and physical setup met good medical standards. In addition there was a school program and two social workers. Also there was much available unused bed space.

On August 23 the first patients were discharged to Newington and gradually others followed until forty-six were transferred. The plan for exchange of data was that a carbon of the Medical Social Service face sheet and a copy of the letter sent to the National Foundation for Infantile Paralysis were forwarded to the social worker who assumed the responsibility for social case work while the child was at Newington Home. Upon discharge from Newington Home, patients were given return appointments to the New Haven Dispensary. The patient's medical and social situation would be reviewed at this point by the medical social worker in the Orthopedic Clinic, and if there were social problems the situation would be accepted by her for further social treatment.

To arrange admission to Newington Home proved to be a complex matter. The rate at Newington Home is $11 per week. Nine dollars of this is paid by the State from funds appropriated by the State Legislature, providing the family goes through the probate court and the child is thereby committed to Newington Home. During the emergency, patients were admitted before these court arrangements had been initiated because of the need to discharge patients from the Hospital in order to make room for new patients. The probate court procedure necessitated personal application of one of the parents at the local welfare department. This agency arranged for the probate court hearing. The cost of the hearing in New Haven County was $15.90 but this court fee was waived in many instances. Also in every case, the family was required to sign an agreement to pay the $2 a week to supplement the amount paid by the State. In case the family might at any time default on this, another paper had to be signed by the town assuming the responsibility. In addition an operative permit was signed by the parents.

At a time when parents were emotionally upset, it was difficult for them not to be disturbed by the details of these arrangements. In every instance it was necessary for the worker to explain that this procedure was to be complied with regardless of income, that the local department of welfare was the logical place to center arrangements for admission to a state-aided agency, and that making such arrangements was not comparable to applying for relief. It was necessary to explain

the difference between this, which was a voluntary commitment and merely released State funds, from an involuntary commitment which means that the child becomes a ward of the State.

The distance between the child's home and Newington Home was another problem to parents. After the enforced three-week period of isolation, when the families could not see the children, it was hard for them to face yet another period when a weekly or bi-weekly visit offered the only opportunity to see the children. The fact was explained that the continuity of hot packs and physiotherapy was interrupted by too frequent visiting. Thirty-seven miles away from a child, even though one could visit weekly, was very disconcerting. The inconvenience and expense of transportation by train and bus and the fact, that children under 16 for purposes of safety could not visit the patients, increased the difficulty of acceptance. Since the families knew that convalescent care away from home might be necessary they often had their minds set on the nearby Children's Center which was already familiar to them.

Arrangements With the National Foundation for Infantile Paralysis.—A letter describing the make-up of the family and the problems as seen by the worker and the family was sent to Dr. Linde, Chairman of the New Haven County Chapter of the National Foundation for Infantile Paralysis, regardless of when the financial assistance was requested. In this way the Foundation's executive secured data about each family which helped in deciding the use of their money. At first it seemed as if the funds would be insufficient to cover the multitude of needs, especially when hospitalization over a period of months seemed indicated. At first, in many instances, the families felt that unless they paid the entire cost of hospitalization, the service given to the patients would not be as adequate or complete. Many families overestimated their ability to pay because they felt they must make certain of care for the patient regardless of the financial cost. It took some time for the workers to realize that these factors were pressing the families, and, as a result, some of the original financial plans were less generous than the later ones. The original plans were revised more appropriately. In almost every instance the Foundation accepted the recommended plan made by Medical Social Service with the family.

Interpretation of Poliomyelitis and the Plans to Come.—The content of the first interview revolved around three topics: the parents' requests for specific information about the patient, hospital plans and procedures, and the services of the National Foundation for Infantile Paralysis. It became readily apparent that the steady giving of pertinent information to the families in response to their questions helped to lessen anxieties and gave a chance for resentments to be expressed. These interviews also served as a definite release from tension. The

following material will show the intermingling and interaction of some of the feeling tones demonstrated by the families and the usual interpretation given by the worker.

General interpretation about poliomyelitis was given in accordance with the family's need and ability to comprehend. In response to questions the family were usually told simply and in a leisurely manner about the disease and the following points were usually covered. Poliomyelitis was caused by a virus which usually attacked the spinal cord. When the virus killed cells, they could not be renewed as could the skin around a scratch on one's arm, but damage was permanent and paralysis occurred in the muscles controlled by the killed nerve cells. Some of the cells probably were not killed and could be helped to do their job by use of Kenny packs and by physiotherapy. The extent of paralysis could not be determined for several weeks or sometimes months because the muscle spasm and stiffness which followed the virus' attack of the spinal cord, masked it. The amount of paralysis could be ascertained accurately only when these had cleared. Hot, moist, woolen packs cut to fit the various parts of the body were applied as often as the doctor ordered. These relieved the feeling of tightness in the muscles, aimed to restore normal muscle tone, and made the patient more comfortable. Physiotherapy was started shortly and muscle re-education by trained therapists would result, we hoped, in normal muscles taking over the function of the damaged muscles.

It was the workers' feeling that the simplicity of this explanation made it easier for the family to grasp the essential points. A too detailed or more complicated medical interpretation seemed to add additional confusion and apprehension.

After resources for convalescence had been organized the worker explained that the patients were almost always in this hospital for the acute, infectious period lasting three weeks and after that, that one of three possible plans might be recommended. The patient might be discharged home if he no longer needed packs and physiotherapy; this would be when the muscle spasm had cleared and there would appear to be no residual difficulty. If, on the other hand, the patient was responding well to packs and physiotherapy, but muscle spasm and weakness were still present, further care away from home would be indicated at a place where the Kenny treatment could be carried out and where physiotherapy would be available. Newington Home and the Children's Center were the only other places equipped to give this treatment. The doctor and social worker together decided which one could offer the most to the patient in terms of his medical needs and the bed space available. The third possibility was that patients who needed additional diagnostic tests or special treatment would remain in the hospital longer.

Just before the end of the three-week isolation period, and following complete examination and evaluation of the patient's condition, the doctors decided which of the three plans was advisable. The worker then arranged an appointment with the family to come to the hospital to discuss plans with the doctor and medical social worker. In a joint office interview the doctor would explain the patient's progress and the basis for the medical recommendations, while the social worker would further interpret the plan of care and assist the family to carry it through. The worker prepared each child, who was old enough to comprehend a simple explanation, for the convalescent plan before it was carried out.

Interpretation of the National Foundation for Infantile Paralysis.— The family was advised of the purposes of the National Foundation for Infantile Paralysis. The social worker explained that medical care was expensive and was often required at a time when a family was least able to pay for it; and that it was possible that funds from the Foundation could be used to pay for medical care when it seemed from a study of the family's income and expenditures that the family was unable to pay completely. A careful budget was worked out in many instances and the worker explained that if financial assistance was not appropriate now, it could always be requested at a later date. The worker further explained to the family that through its County Chapters the National Foundation for Infantile Paralysis had allocated funds, raised in the local chapters in the county in which the patient lived, through the "March of Dimes" and President's Birthday Ball. This money was to be used on the basis of need for patients with poliomyelitis. The Foundation recognized the difficulty which families might experience in paying for long-time medical care and wished to ease that burden when the load was too great for the family. Because of the number of patients in this epidemic some of whom would need hospital care for long periods of time, the Foundation felt that families should attempt to meet the medical expense incurred according to its financial ability to do so.

Barely more than one-half of the one hundred seventy-two families secured partial or complete financial assistance with hospitalization costs ($6 a day) from the National Foundation for Infantile Paralysis. The remaining slightly less than one-half were found, after study, to be able to meet the total expense of hospitalization. With five exceptions the families reacted favorably to the interpretation of the Foundation and the financial arrangement jointly made. It was to be expected that the families with more adequate incomes were more hesitant to talk over their financial situation so that a decision could be made in a businesslike fashion.

The emphasis in the second interview was a positive thing: "Your child has improved." When convalescent care away from home was

indicated, it was pointed out that we were fortunate to have adequately equipped convalescent places. The family had acted wisely to bring the patient to the hospital as early treatment was most essential. Continuing the treatment according to the same method was just as important and could be accomplished in these convalescent homes.

Reactions of the Children's Families.—The following section covers the reactions of the children's families. The reactions of the adult patients are discussed later in a separate section since the experiences of the two groups were quite different during their hospitalization.

All of the families were concerned and disturbed when they found they could not see the doctor after admission until just before the time of discharge.

Inability to See the Doctor: In general, when families telephoned they were told they could not be connected with the doctors, but that they could secure a report from the report operator at a definite hour every afternoon. This report phrased in terms of good, fairly good, or serious, precipitated considerable anxiety. Persons who telephoned frequently or who seemed somewhat disturbed were transferred to the medical social worker and in this way further interpretation was given. The worker went to see the patient and secured specific information from the doctor or nurse about his condition before calling the family. Information to referring physicians was handled in the same manner. The staff at the Information Desk of the hospital, who received innumerable requests, likewise referred troubled families to the workers. The worker explained to the families that we regretted that the pressure on the doctors was so great that it was not possible for them to see families and at the same time give adequate care to the increasing number of children coming into the hospital. It was explained that in spite of limited medical staff, this hospital, connected with a medical school, was better staffed than many in this emergency. It was explained, also, that patients from all over the southeastern section of the state came to the New Haven Hospital because of the isolation ward and added thus to our usual pressure and that because of the size of the epidemic and in order to give adequate treatment to the patients the doctors needed all their time to give care to patients. We believed that the parents would agree that the treatment of patients came first and that they would understand that there were not enough staff members to see the parents as well. The worker explained that she was available by telephone, that she visited the patients on the ward and could help with problems about the patient's adjustment in the hospital and the plans for his care later. The parents were given the worker's name and telephone number.

To supplement the information given by the medical social worker and to afford the families an opportunity to talk to a doctor, three talks were given by the Resident Pediatrician to groups of families

during the time the doctors were unable to see them in the usual manner. In this way, the doctor in charge of the treatment program was able to interpret what was being done for the children and the organization within the hospital for this. His appearance, showing evidence of fatigue, and his very apparent interest in each patient, did much to relieve worried families and to establish confidence and understanding in the care being given. Each family was given an opportunity to ask questions about its patient, and the physician gave specific, direct information which was most helpful to families. This method of meeting families in a group helped to build up the morale of each family and saved considerable time of the physician by giving the interpretation to a group rather than individually.

Ninety-two per cent of the families were concerned because they could not see the doctor. Seventy-two per cent seemed able to accept the reasons why the doctors were not available. Twenty-eight (18%) of the families reacted more markedly, showing evidence of increased anxiety. The amount of anxiety produced appeared to be related to their personality needs and general level of maturity. Feelings of responsibility, evidences of instability, tenseness and rigidity seemed characteristic of these twenty-eight families.

Reactions to Separation: The present isolation building of New Haven Hospital is an old, three-story structure. It lacks modern porches or facilities which would permit families and patients to see each other in such a way that communicable disease is not carried. Consequently some families of the patients went evenings to the outside of the isolation building and called to the children, one, two or three floors above them, in an effort to ascertain, with their own eyes, how the children were. They thought they saw their children standing up in bed or walking around the ward, and became most concerned and fearful that treatment orders were not being observed, or that the children were completely well and were being unnecessarily retained in the hospital. The parents compared notes on their talks with the social workers and other personnel and became quite disturbed in contrasting experiences and imagining points of difference. Each morning there were many telephone calls to talk over the new thoughts aroused by these experiences.

One hundred and nine (71%) of the one hundred and fifty-three families about whom there was sufficient information to tabulate were able to accept the need for isolation of their child when the reasons were given. Thirty-two more parents (21%) were markedly distressed and unable to accept it without marked anxiety. Twelve (8%) of the families were distressed to an even greater degree; these were individuals who were less intelligent, showed more feelings of blame, and seemed more immature or unstable in their reactions. The way in which some

individuals reacted to separation is illustrated in the four following situations, which show differences in the extent of the reactions.

Mrs. D., mother of a precocious, 3½-year-old daughter, was proud but jittery. She was unable to control her anxiety. From the moment she first glimpsed the worker she spilled out quick, compulsive questions barely pausing to get the answers. "Is Millie paralyzed? How much is she paralyzed? Is she unhappy? How much can she move? Does she eat at all? Is she crying?"

Millie is the only child of intelligent parents who have been living under conditions of strain for some time. Mrs. D.'s aunt has been with them for over four months. She is a complete bed patient and requires constant, exacting care.

Mother and child had never been separated. The patient insisted "mummy" was out in the hall not being allowed to come in to see her and she was definitely unhappy. Her mother was given interpretation by telephone and in interviews. Millie became adjusted to the hospital, gradually began to eat and sleep better, and to be less active and more friendly.

Mr. D., a calm man, said his wife would be the next patient if she could not see Millie.

Mrs. D. seemed to be reacting with anxiety to separation from a small child who was very dependent on her. A large degree of her anxiety appeared to be within normal limits under the circumstances.

Four-year-old Ben is the oldest of three children of young American-born parents. His mother, of Lithuanian extraction, is tense and concerned about Ben. Her husband is Italian, hot tempered, and likely to go ahead before he thinks things through. He is a graduate of a college of physical education where he learned something about physiotherapy. The family own an adequate home, with a pretty garden off the playroom. The patient's father teaches Physical Education earning around $2,400 a year for the support of the family of five.

From the start, Mrs. F. was suspicious of our motives in interpreting the National Foundation for Infantile Paralysis and seemed reluctant to discuss finances in a businesslike way. After consultation with her husband, a financial plan was made.

Mr. F.'s attitude was critical of hospital treatment. His brother, a local physician, was using electrotherapy treatment in his practice and this treatment was not given at New Haven Hospital. Mr. F. questioned this and the doctors thought the patient might be removed against advice.

At the time Ben was in the hospital plans for convalescent care for all the patients were not definite. Consequently the interpretation given this family had to be tentative and not as full as was possible later. In a home visit the worker explained that we were hoping to work out plans at home, but did not know then whether this would be possible.

At the time a plan for convalescent care away from home was recommended, the worker telephoned the family to make an appointment to discuss plans. As the family had no telephone, a message had to be given through the patient's grandfather. Mr. and Mrs. F. appeared at the worker's office in a very few moments. Mr. F. looked poised for battle with belligerence oozing from every pore. His wrath poured out on the worker. "She had exceeded her authority. What right had she to make financial and convalescent plans? What was her position in the hospital anyway? He must see a doctor, he must see Ben. We had told him he was to come home and now we had sprung this. He could give Ben physiotherapy at home. His wife could give him packs." No amount of explanation could sway Mr. F. "They were a home-loving family. He and his wife would sacrifice to the end of their days to have the patient at home."

As it was obvious that only a doctor could settle this matter, the Chief of the Pediatric Service talked to Mr. F. and one of the orthopedic physicians talked to

both parents, while the worker was present. Both answered their questions fully and advised convalescent care at the Center. It was clear that Mr. F. wished to carry on at home even though the patient would not be able to have orthopedic care there. His wife hesitated to assume this much responsibility for the future of her child. The family, after discussing the situation with their physician, decided to take Ben home. Mrs. F. was taught on the ward to do the packing. The worker told the family she would be glad to help with convalescent care later on, should they decide in favor of it.

In this situation, we see a dominant husband and submissive, passive wife. Mr. F. was assertive, impulsive, aggressive, belligerent and hot tempered when confronted by this difficult decision. His fear of crippling and his great desire to meet some of the patient's needs are demonstrated by his aggression and by blaming the hospital and the worker. Self-gratification became primary rather than the patient's welfare. He preferred to risk his son's future in order to have immediate relief for himself through Ben's presence at home. He became emotional and unable to think clearly. He did not consider his wife's feelings in the matter, disregarded the staff's recommendations and planned to give physiotherapy unlike that given at the hospital, although he understood that such a procedure might destroy the benefit of the treatment already given. Emotionally immature, in his inability to place the patient's long-time benefit before his own immediate emotional needs, separation from the patient and lack of direct contact with the doctors right along had swung him into an unsound course.

Again this situation illustrates what happened when a parent was unable to see the patient or to talk to the doctor directly about the patient's progress, and shows that an already anxious, unstable person can tolerate less additional anxiety.

RoseMary, 6 years old, came into the hospital for the first time with infantile paralysis. She flew into a rage whenever it was necessary to examine her. She hardly spoke on the ward.

Her father, a tense, anxious person was seen in Psychiatric Out-Patient Clinic in 1940 and diagnoses of psychopathic personality and manic-depressive psychosis with obsessive fears were made. Hospitalization was advised but instead Mr. T. came for out-patient treatment for a short time. His wife had died five months before the patient's admission, after hospitalization and long-time nursing-home care. She was the stable, household manager on whom Mr. T. had depended greatly. Shortly after the mother's death another child was severely ill with meningitis and hospitalized for a month. In addition, there were indications that the patient's father did not like his job. His $43 a week salary was barely adequate with the drain of medical expense in addition to the needs of his four children and himself. At the present time he is paying on medical bills amounting to $400. He had had to break up his home and was living with his mother-in-law.

Arrangements were made for the Foundation of Infantile Paralysis to assume the hospital bill and costs of convalescent care. Reassurance and interpretation of the patient's condition were given Mr. T. and the referring physician, who was influential in helping Mr. T. accept convalescent rather than home care.

Mr. T. was so agitated and insecure that he could not see "the forest for the trees." A series of serious, disrupting calamities had befallen him, which would

have demanded much stability to face well. Inability to see the patient and the doctors made Mr. T's adjustment much more difficult.

Mrs. S., mother of Mary, had had a reactive depression in relation to another unwanted child. Her husband, an ex-fireman, said her increased excitability and distractibility were precipitated in time of family crisis.

Physical separation from Mary coupled with inability to see the doctors brought this mother almost to the point of hospitalization for mental illness. She pounded with question after question. "Will Mary be paralyzed? Where will she be paralyzed? Can she come home? When can she come home? Will she go to the Children's Center?" Although lengthy explanations were given, her only answer would be a similar question. She bombarded the information desk, the report operator, the medical social worker, and the psychiatrist with the same questions over and over again. In her eagerness to see Mary she tried to climb the fence near the isolation ward, cut her hand, and would not accept treatment in the emergency room. Time and again she tried to dash by the admitting clerk to reach the isolation ward.

The pediatric psychiatrist saw Mrs. S. two or three times a week during Mary's hospitalization to give her some relief from her anxiety and to prepare her for a plan of convalescent care for Mary away from home. Meanwhile the social worker reassured Mr. S. and kept him informed of plans. The psychiatrist placed Mary in the ward where her mother could see and talk to her through the window. Since repeated reassurance brought little change in Mrs. S.'s agitated concern, the doctor tried to help Mrs. S. understand the seriousness of her anxiety and suggested a period of hospital treatment. Mrs. S. reacted to this negatively, but thereafter became more manageable.

She gradually became more calm and accepting. Luckily for Mrs. S. the final orthopedic examination showed that convalescent care away from home would not be necessary and Mary went to her own home for bed rest and follow-up in orthopedic clinic. Before discharge, plans were made so that other members of the family would assume a good share of Mary's care at home. Further evaluation of Mrs. S.'s mental status will continue through the psychiatrist and Mrs. S. will be directed to a resource giving psychiatric treatment when and if she and the family can accept it.

In these four situations we see parents, tense, overactive, very concerned, usually able to face the daily problems of living, but always with a considerable degree of anxiety. Here anxiety is tremendously increased by the extra uncertainties resulting from not seeing the ill child or talking to the person who was giving him care.

Feelings of Responsibility for the Illness: Feelings of responsibility for the illness seemed to be expressed by those parents who reacted with more than average anxiety to their child's illness. Mrs. D., whose pattern was that of a tense, overactive, anxious person, thought she had been negligent. She had feared that the patient would get poliomyelitis right along. We have only hints of strong underlying bases for her feelings. Mrs. S.'s reaction that Mary's illness was all her fault was based on her early rejection of the child. Her feelings were so strong that she would reject all outside treatment for herself until Mary's improvement gave her emotional relief so that she could redirect her energy to carry on to her own goals.

Fear of Crippling: The questions asked by each family of the doctor and worker indicated fear of severe handicap for the patient. One time this might be expressed in the form of, "Is he able to feed himself with his right arm?" indicating fear of permanent paralysis in that arm, or in the case of a child with much leg involvement, "It breaks my heart when he spent every minute playing football," leaving unsaid, "I know he never can again." The grandmother of one child said, "It's a pity for a child to start out so handicapped." One of the children expressed her fear to her parents when they were about to refuse the recommended convalescent care, "I want to be able to ice skate and to dance." An unusually articulate mother said, "I'd rather have Susie die, than live with a limp."

One hundred twenty-two (79%) of the one hundred fifty-three families, studied with this in mind, were not able to express their fear about crippling directly. Twenty-four (16%) more, through their additional anxiety and reiteration of key questions, showed that the possibility of crippling was real to them. Seven other sets of parents and one child (5%) clearly articulated and stressed the meaning of crippling to them. Once again, as in the case of reactions to separation and to inability to see the doctor, the less stable, more anxious people were most troubled.

It seemed obvious that, while not directly expressed in many instances, the fear of permanent paralysis and inability to live normally because of it, was active in the minds of the parents and older children.

Feelings About the Diagnosis: Because the referring physician had prepared the family for the diagnosis of poliomyelitis, the acceptance of this as definite was easier. It was a relief for them to know definitely and to go ahead with plans for the patient.

Difficulty in accepting the diagnosis occurred in situations in which the establishment of the diagnosis jeopardized plans previously made. The two brief descriptions below are indicative of the type of situation in which lack of acceptance of the diagnosis occurs. There were only three cases in which the family seemed unable to accept the diagnosis.

The patient, a 9-year-old girl, was in the hospital only five days. Just before discharge, a diagnosis of abortive, nonparalytic poliomyelitis was reached. Isolation precautions, complete bed rest and follow-up in orthopedic clinic were recommended.

The worker called the referring physician (in another town) to determine whether the parents could carry out the plan at home. He said the family did not believe that the patient had poliomyelitis.

The family situation gave some illumination. The patient's mother was pregnant; her delivery, expected daily, was to be carried out in a local hospital. Should the patient return to the home, with poliomyelitis, and with her mother caring for her, the mother would be refused admission to the local hospital for fear of spread of poliomyelitis to the other patients. It seemed advisable from the point of view of adequate care of the patient and her mother to plan convalescent care with relatives who had no children who might be exposed by the patient's presence.

The family eventually agreed to allow the paternal grandmother to provide the needed convalescent care and the local health officer approved this arrangement.

Another patient was a 4-year-old girl, one of three children of parents working in local industries. When the worker explained to the parents that the diagnosis of poliomyelitis had been established, they were sure she was misinformed. The patient had been bitten by a dog previous to her hospital admission and the family believed her condition was due to the bite. The matter had been put in the hands of a lawyer. It was obvious that the case could not be carried to a successful conclusion in court if a diagnosis of poliomyelitis was admitted by the family. The lawyer and parents continued to disbelieve the diagnosis in the discharge interview with the doctor and worker and used pressure on the worker to accept their point of view. Although the patient needed convalescent care away from home, the family resisted this plan and took the patient home against advice, saying they would secure a local physician to treat her at home. Evidently the diagnosis in their minds even at discharge was still "dogbite," rather than poliomyelitis.

The workers felt that twenty-one of the fathers and fifteen of the mothers were especially emotionally immature as demonstrated by their reactions to the illness of their child. With so small a number of patients it is not significant that one-third more of the fathers, in contrast to the mothers, seemed obviously immature.

Seeming Acceptance of Plans for Patients: Sometimes apparently complete acceptance of all plans is symptomatic of lack of real acceptance of recommendations. In one situation, the family did not respond to telephone messages or letters, but had very plausible excuses for not doing so. This family had also taken the patient to four doctors, all of whom made a diagnosis of poliomyelitis, before the parents brought the patient to the hospital. In response to a telegram, they came to the office to see the doctor and worker. They appeared interested, concerned, asked minor questions and agreed readily to take the patient to Newington Home, which had been suggested for convalescent care. Two days later we discovered the patient had not arrived at Newington Home but had been taken home and that a local orthopedic physician was now following her. Certainly the lack of initial interest and indifference as to the patient's condition plus the reputation of irresponsibility on the part of the patient's father and family, secured from social agencies, would indicate that the patient's future care might be questioned.

Family's Need to Participate in the Treatment Plan: There were other evidences which showed the inability of the family to place the long-time goal for the patient ahead of the immediate need to participate in the physical care of the patient.

Mr. and Mrs. K., a young Scotch couple in middle class circumstances, were very much concerned about their 7-year-old son's condition. They agreed to convalescent care, but after the child was at the Center they found it increasingly difficult to see progress in the patient when they visited once a week. They were continually upset by the critical interference of relatives. Mrs. K. finally succumbed to an advertisement which promised to teach the Kenny method of physiotherapy. She took lessons and planned to take the patient home, carrying on with her newly

learned physiotherapy. Fortunately, she and her husband were given the opportunity to discuss their feelings about the patient's care at the Center with the medical social worker, and they reached an independent decision that they did not want to risk the patient's future health and happiness by interrupting his normally slow, but improving convalescence.

Inability to Comprehend: Again under stress one sees the family losing objectivity and perspective when dazed by an acute illness such as poliomyelitis and the uncertainty of the actual outcome of even the most adequate medical care. In a number of cases when the worker interpreted the possibility of care at home only if nursing and physiotherapy could be provided, she was quoted later by the family as having definitely stated that the patient was coming home. The family would, in their desire to make this plan possible, have bought or borrowed a washing machine and have taken other steps, which should have been taken only after it was certain that nursing and physiotherapy could be provided.

The inability of a family to assimilate interpretation in time of stress was frequently demonstrated. One family's insistence that there had been no explanation of the patient's condition resulted in long interpretative interviews by the resident, intern, doctor in charge of administration and the medical social worker. In all good faith the family had made its needs known and each person had attempted to give the family the necessary information.

Again and again under the emotional strain of separation and the need to protect and care for the patient at home, the family frequently said: "When you telephoned us to come in and discuss future plans, we thought it surely meant that the patient could come home." In spite of interpretation to the contrary in a previous interview from the worker and the doctor at admission, under stress the families found temporary release from anxiety by believing what they needed to believe.

A positive, balanced, all-around adjustment:

Mrs. M. and her husband have six children between the ages of 11 and 2 years. Danny, the patient, a roguish, active boy is the oldest. Mr. M. is a policeman on leave of absence for the duration, as he is a skilled steamfitter and has materially increased his income by changing jobs. He now earns $57 a week.

Both parents were naturally troubled by their son's illness, but realized that the hospital was the best place for the patient. Mrs. M. stated their financial situation clearly, indicating that they would like to do their share in payment of the hospital bill. They had reduced a debt, product of the depression years, to $160, and were paying on a bill of $150 for previous medical care. As Mr. M. had gastric ulcers he was under medical supervision. To budget for medical care, needed frequently for a family of seven, they had taken out hospital insurance. An arrangement was made for them to assume $10 of the $31 hospital bill, while the National Foundation for Infantile Paralysis assumed the balance.

When faced with plans for convalescence away from home, Mrs. M. said they realized that she was not trained to give packs and physiotherapy at home and that with a large family to care for they had anticipated some other plan. They had

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Another patient was a 4-year-old girl, one of three children of parents working in local industries. When the worker explained to the parents that the diagnosis of poliomyelitis had been established, they were sure she was misinformed. The patient had been bitten by a dog previous to her hospital admission and the family believed her condition was due to the bite. The matter had been put in the hands of a lawyer. It was obvious that the case could not be carried to a successful conclusion in court if a diagnosis of poliomyelitis was admitted by the family. The lawyer and parents continued to disbelieve the diagnosis in the discharge interview with the doctor and worker and used pressure on the worker to accept their point of view. Although the patient needed convalescent care away from home, the family resisted this plan and took the patient home against advice, saying they would secure a local physician to treat her at home. Evidently the diagnosis in their minds even at discharge was still "dogbite," rather than poliomyelitis.

The workers felt that twenty-one of the fathers and fifteen of the mothers were especially emotionally immature as demonstrated by their reactions to the illness of their child. With so small a number of patients it is not significant that one-third more of the fathers, in contrast to the mothers, seemed obviously immature.

Seeming Acceptance of Plans for Patients: Sometimes apparently complete acceptance of all plans is symptomatic of lack of real acceptance of recommendations. In one situation, the family did not respond to telephone messages or letters, but had very plausible excuses for not doing so. This family had also taken the patient to four doctors, all of whom made a diagnosis of poliomyelitis, before the parents brought the patient to the hospital. In response to a telegram, they came to the office to see the doctor and worker. They appeared interested, concerned, asked minor questions and agreed readily to take the patient to Newington Home, which had been suggested for convalescent care. Two days later we discovered the patient had not arrived at Newington Home but had been taken home and that a local orthopedic physician was now following her. Certainly the lack of initial interest and indifference as to the patient's condition plus the reputation of irresponsibility on the part of the patient's father and family, secured from social agencies, would indicate that the patient's future care might be questioned.

Family's Need to Participate in the Treatment Plan: There were other evidences which showed the inability of the family to place the long-time goal for the patient ahead of the immediate need to participate in the physical care of the patient.

Mr. and Mrs. K., a young Scotch couple in middle class circumstances, were very much concerned about their 7-year-old son's condition. They agreed to convalescent care, but after the child was at the Center they found it increasingly difficult to see progress in the patient when they visited once a week. They were continually upset by the critical interference of relatives. Mrs. K. finally succumbed to an advertisement which promised to teach the Kenny method of physiotherapy. She took lessons and planned to take the patient home, carrying on with her newly

learned physiotherapy. Fortunately, she and her husband were given the opportunity to discuss their feelings about the patient's care at the Center with the medical social worker, and they reached an independent decision that they did not want to risk the patient's future health and happiness by interrupting his normally slow, but improving convalescence.

Inability to Comprehend: Again under stress one sees the family losing objectivity and perspective when dazed by an acute illness such as poliomyelitis and the uncertainty of the actual outcome of even the most adequate medical care. In a number of cases when the worker interpreted the possibility of care at home only if nursing and physiotherapy could be provided, she was quoted later by the family as having definitely stated that the patient was coming home. The family would, in their desire to make this plan possible, have bought or borrowed a washing machine and have taken other steps, which should have been taken only after it was certain that nursing and physiotherapy could be provided.

The inability of a family to assimilate interpretation in time of stress was frequently demonstrated. One family's insistence that there had been no explanation of the patient's condition resulted in long interpretative interviews by the resident, intern, doctor in charge of administration and the medical social worker. In all good faith the family had made its needs known and each person had attempted to give the family the necessary information.

Again and again under the emotional strain of separation and the need to protect and care for the patient at home, the family frequently said: "When you telephoned us to come in and discuss future plans, we thought it surely meant that the patient could come home." In spite of interpretation to the contrary in a previous interview from the worker and the doctor at admission, under stress the families found temporary release from anxiety by believing what they needed to believe.

A positive, balanced, all-around adjustment:

Mrs. M. and her husband have six children between the ages of 11 and 2 years. Danny, the patient, a roguish, active boy is the oldest. Mr. M. is a policeman on leave of absence for the duration, as he is a skilled steamfitter and has materially increased his income by changing jobs. He now earns $57 a week.

Both parents were naturally troubled by their son's illness, but realized that the hospital was the best place for the patient. Mrs. M. stated their financial situation clearly, indicating that they would like to do their share in payment of the hospital bill. They had reduced a debt, product of the depression years, to $160, and were paying on a bill of $150 for previous medical care. As Mr. M. had gastric ulcers he was under medical supervision. To budget for medical care, needed frequently for a family of seven, they had taken out hospital insurance. An arrangement was made for them to assume $10 of the $31 hospital bill, while the National Foundation for Infantile Paralysis assumed the balance.

When faced with plans for convalescence away from home, Mrs. M. said they realized that she was not trained to give packs and physiotherapy at home and that with a large family to care for they had anticipated some other plan. They had

faith in the treatment given at Newington Home and the Children's Center. Mr. M. had been talking to the patient daily through the isolation ward windows and Danny was prepared for and understood that convalescent care away from home was most likely.

The two interviews with the M.'s make one feel that they understood and were aiming for adequate, continuous medical care for the patient so that he would have the best chance for optimal improvement. Every other consideration in the treatment plan was secondary to this. One has the feeling that this family is self-reliant, adaptable, relaxed, and sufficiently free from anxiety to meet difficult situations adequately. By their interpretation to the patient, they made his adjustment easier.

A Negative Reaction to the Convalescent Plan: The following case study demonstrates an extreme reaction to plan for convalescent care away from home. It also shows how impossible it is to separate the feeling tones in one situation. Here are mingled reactions to separation, and the more basic underlying patterns of the parents' personalities, all the more startling in contrast to the positive, well-balanced reactions seen in the preceding case illustration.

Almira, 11 years old, was seen by the worker shortly after she was admitted. She was the older of two children of Polish-born peasants. She was crying quietly in bed, seemed frightened, and lay back in her bed as we approached. It was the first time she had been in the hospital, she said. We explained that we would be getting in touch with her family, and wondered if she had messages to send, but Almira was too shy to give them. We told her we would be coming to get acquainted with her on the ward. In response to our question, she said she was not having any pain.

In our telephone conversation with Almira's mother, there was much eagerness for news of the patient. Her mother's voice was agitated. "Is she still weeping? Is she going to die?" The worker explained that weeping was a natural reaction to separation from her parents, and that as the patient was transferred to an open ward with children of her own age who ate, slept, and had packs when she did, she, like the rest of them, would probably be much happier. The mother's comments indicated that she expected the patient not to adjust but to continue to weep for the family. She said neither her husband nor she could either sleep or eat without her.

We indicated that people did not die whenever they came to the hospital, but usually got better. From reading Almira's chart it seemed to us that she was getting along nicely and that time and regular treatment were what Almira needed and was getting.

Mr. H. was an ignorant, unassimilated, Polish-born peasant who spoke little English, though he understood what was said. He tried to be the all-powerful father and to have a submissive wife and children. His wife deferred to him about everything. He was blunt and resentful about having to come in. The patient was here; it was hard on him to have her away from home. The usual interpretation of the lack of contact with the doctor, the disease, and its course was given. His wife listened. He seemed impatient, anxious to be off. We explained the interest of the National Foundation for Infantile Paralysis in Almira and wondered if they would like to talk about that. Mr. H. assured us he would pay the bill and as it was impossible to secure sufficient data to evaluate his ability to pay, we felt it best to let the matter of hospital expense drop for the moment.

The father asked us to talk with the patient's godfather about the matter when he came to town on Saturday morning and this was done, the worker feeling

that an understanding and acceptance by his friends would increase Mr. H.'s faith in the hospital and further clarify the reason why he could not see his child in the hospital.

The worker had in the meantime acted as messenger between the family and the patient, taking the gifts the family brought each time. Gradually the patient become more accepting of the worker and adjusted better on the ward. She was surrounded by girls of her own age, and while more quiet than some, talked with them, seemed more confident and cheerful, and was no longer weeping. The packs made her more comfortable. She was cooperative about treatment and during the process of getting better acquainted the worker told her of the possibility of convalescent care later on. She seemed interested in the description of convalescent care and especially pleased that she could continue with her schoolwork. She immediately asked if she could see her parents. We explained there was visiting once or twice a week and that that would be much better than here. She said she would be quite glad to go and turned to tell some of the other girls about the chance of it.

On the twentieth day of Almira's hospital stay the worker received a message to call the family. The family was already on the way to the hospital to take Almira home. In midafternoon, the patient's father, mother, and the minister came to our office. Mr. H. paced up and down and repeated over and over that he had come to take Almira home. He could not eat or sleep; he needed Almira and must have her at home now. We explained that, before any patient left, the doctor and social worker talked with the family to explain how the patient was and what the doctor thought would be the best plan for the patient. Mr. H. did not want to see the doctor. "I just want my Almira home." The doctor was unable to come for some time and the worker felt it best to attempt to talk things over as much as possible in the interim. We explained that the patient was much better than she had been but that she needed the packs and physiotherapy which could not be given at home. Almira did not need to be in the hospital but did need a place like the Children's Center, where packs and physiotherapy were given, so she would have the best chance to get well. Mr. H. reiterated that he had come to take the patient home. His wife in her submissive way, when asked, indicated she thought the Children's Center would be better than home care, but that the decision was her husband's. When asked what he planned to do in way of treatment for Almira at home, Mr. H. shrugged his shoulders and said he didn't know.

When the doctor came, the father repeated that he wanted to take Almira home regardless of the fact that she was happy about the plan for convalescence.

At this point it was decided to waive the "nonvisiting rule" to see if the patient's acceptance of the Children's Center plan would affect the father.

The worker prepared the patient, explaining that her father did not understand the plan for care at the Children's Center and that we thought she could explain it to her father and mother. She immediately said she wanted to go to the Children's Center. She wept and showed her father how she had improved, moving the leg in which she had movement and showing how much better it was since treatment here. She wanted to ice skate and dance and going there would help, she knew. Her father melted at her complete conviction, evident desire, and reassurance to his repeated questions. She pointed out that she could see them during visiting hours there, so that would be wonderful. The family took her to the Children's Center the following day.

Probably the father's inability, without help from the hospital and convalescent center, to care properly for the acute medical condition of his daughter was a great threat and aroused his concern. His need for the patient to come home was greater than his regard for her future health even if this should mean crippling. He could not face lack of his sole control over a girl child. It was interesting

that the patient could express to the worker her realization that her father would not see the need for her care away from home. She said she was scared that he would not accept it even when she told him how much she wanted and believed in it.

The Reactions of the Adult Patients and Their Families.—The number of adults served by the hospital was small enough so that the medical staff of the hospital did not have to be reorganized to meet the new pressures. Study and treatment of the thirteen adults known to social service demonstrate that there are certain differences in problems and reactions in this group in contrast to the children with poliomyelitis. Each patient and family group had a distinct personality, but things seemed to move more smoothly. The patient and family had ready access to the doctor so there was one less area for the expression of hostility and resentment. Perhaps the smoother movement in the adult cases is characteristic of how things might have been facilitated, had the doctor been able to play his usual role with the far larger group of ill children whose families had to be deprived of the normal relationship with the doctor.

In general, the problems were basically the same, with the exception that the adults had a longer hospital stay as there were no convalescent resources available. Resources had to be organized and integrated on an individual basis. Thus discharge plans were held up pending the complicated process of finding suitable resources. Because the peak pressure for the social service department during the epidemic came at the time when the majority of the adult patients needed service, the worker's relationship was no more sustained than with the families of the children. The worker, knowing the strength of the close doctor-patient-family contact realized by the adult patients, frequently did not initiate a contact with the patient until the doctors advised her that planning for convalescence should be considered. In four of the thirteen cases the pressure of family problems created restlessness on the part of the patient, which made it necessary to change the original plans. Three of these patients were women with children and husbands at home about whom they were worried. The following case illustrates these characteristics.

Mrs. G. was the 30-year-old mother of two children under 3 years of age. She was obviously devoted to her husband and the children and in spite of little formal education managed the children fairly well though with little sensitivity. She became restless and troubled because she was worried about the children. Her husband's letters did not reassure her that all was going well although she knew that both children were home at night and that her husband took one to a nearby relative and the other to a neighbor for daily care. As the patient could not seem to relax, but continued to be tense and disturbed, the doctor and worker made arrangements for the "no visiting rule" on isolation to be waived and her husband visited regularly twice a week. Still Mrs. G. continued to be restless, and she told the worker that a few days more in the hospital were all that she could manage. Through interviews with the patient and her husband it became apparent that Mrs. G. had a pattern regarding early discharge from the hospital. In two

previous hospital admissions the patient had left before it was advised by the staff and, while she was not discharged against advice, the discharge date had been moved forward to meet her requests.

Feeling that little more could be accomplished at the hospital in view of the patient's attitude, the orthopedist advised care at home. Ideally this meant complete bed rest, orthopedic supervision every two weeks, hot packs at frequent daily intervals, and physiotherapy for an hour three times a week.

Her husband was devoted to the patient and showed affection and responsibility toward the children. He had a married sister, a trained nurse, who arranged to drop her own family duties to stay with the patient, supervise her bed rest, and to learn packing at the hospital so that she would be trained to give this treatment. The family planned to have an orthopedic physician who lived in a nearby town and was prepared to give Kenny treatment.

The problem of arranging physiotherapy took several weeks to plan. The physiotherapists of the State Crippled Children's Division, trained in the Kenny method, were associated with hospital clinics and had no free time to give to this patient's care. Two other physiotherapists were suggested, but neither one could be used as she had not had the Kenny training. Finally it was arranged for one of the hospital physiotherapists, who was Kenny trained, to go in her free time by train to the patient's home three times a week, and the National Foundation for Infantile Paralysis agreed to pay her expenses.

It is evident that the shortage of Kenny physiotherapists created many problems in this case. It was fortunate that, with the few orthopedists available who had Kenny training and with the shortage of nurses, home plans could be concluded satisfactorily in most of the adult cases.

The following case of an adult demonstrates the same difficulties in securing adequate treatment in the home. Here the problems were very similar to those in the first case, but are met with a depth of understanding, and intelligence and initiative far beyond that of the G.'s. There is a difference in backgrounds, standards of medical care, and in ability to face, meet, and plan ahead for an uncertain future.

Mrs. B., 23 years, and her only child, 20-month-old Judy, were admitted together. In addition, Mrs. B. was three months pregnant.

Both Mr. and Mrs. B. were intelligent, well-educated people who had sufficient insight to make the best of an experience.

Both were helped by the orthopedist's frequent visits to Mrs. B. on the ward and his explanations about her condition. Both were relieved to know that she would deliver normally.

Mr. B., 26 years old, was obviously well adjusted and controlled in his meeting of the tremendous problems which faced him. He seemed shy and spoke hesitantly but earnestly with just the right degree of courtesy and thoughtfulness. He was earning $60 weekly on a defense job and had already paid a large share of the hospital bill with the $300 which they had been saving toward a farm. He was analytical, methodical, freely discussed his financial position, and expressed his willingness to assume his obligations to the extent of his ability. He showed much warmth and affection for his wife and child. His attitude toward the hospital personnel was one of great interest, followed by a determination to work out arrangements for his wife's care. He was responsive to interpretation from doctor and worker and came to the worker for advice and encouragement as to next steps. He arranged for approved physiotherapy in the home and for his sister to take over the household and for both of them to learn Kenny packing. He arranged for draft deferment on the basis of illness within the family.

Mr. B. said of his daughter, Judy, obviously greatly damaged by poliomyelitis and on the danger list for weeks until discharged to the Children's Center for prolonged convalescent care, "I know Judy may never walk again, but at least we have her." Both he and his wife realized the extra hazards involved in the care of a severely handicapped child and "hoped to be wise in bringing her up." They were able to discuss with the worker the ways in which one could prevent an attitude of invalidism from developing as Judy grew.

Although both Mr. and Mrs. B. were adequate, well-adjusted people, taking crises in their stride, both found the reassurance and support of the social worker and doctor helpful. Mr. B. verbalized this often and expressed it in a letter to the worker.

The first adult case shows the medical social worker being used to locate and plan resources to solve the immediate problem of home care. The second family used the worker for this purpose, too, but went beyond this to discuss the problems ahead for their child whose life because of bodily crippling will be unlike that of the physically normal child.

The adult patients had the opportunity to discuss their fears and feelings with the doctor and their families and were gradually prepared for the implications and the realities involved in the disease. More frequently care at home was arranged so that they were not separated from their families. The adults were able to think what this illness might mean in terms of their future living. Except in a few cases, the children were not mature enough to do this, and the additional burden of making a decision for a dependent child and thinking through the implications of his illness, devolved upon the parents.

Techniques of the Medical Social Worker.—Authoritative Approach: As the medical social worker increased her function in this time of community emergency to take on more of the doctor's role in interpretation, it was necessary for her to change her interviewing techniques accordingly. In giving the medical diagnosis and only available plan for convalescent care, her approach, like the doctor's, was authoritative. This approach was fostered by the need to clear the wards, jammed with five to eight times the usual number of patients, without a lag between readiness for discharge and time of discharge. It was realized that in time of great emotional stress, when vital decisions must be made in short order, the direct method, used with kindness and sincerity and indicating the course to be taken, is a very steadying influence. It was this part of the doctor's function which the worker attempted to carry over to the parents and to adapt to their particular needs as demonstrated by their words and manner. In so far as possible the information was given quickly to avoid additional suspense and worry. While the family was absorbing the upsetting news, the worker continued the interview with pertinent information to which they could listen and through which they had the opportunity of gaining more control of their immediate feelings. At a time when one is too stunned to think, the willingness of another person to take a large share of responsibility

in an important decision is helpful. The help which the worker could give in facing the realistic situation with the family and helping them to think it through resulted in sufficient acceptance of the plan so that continued care was carried out in most cases.

Thus the use of the authoritative method was implicit in each interview. In one hundred and forty-five interviews with families this approach was accepted, while in sixteen instances there was more than usual resistance in varying degrees in accordance with the immaturity or emotional instability of the family group. It was noticed that this role was less needed when the doctors gave direct interpretation to the families, when the patient did not need care away from home, and when the hospital stay was very short because of abortive poliomyelitis.

Building Confidence in Hospital Service: The worker at every opportunity made an effort to build up the family's confidence in the hospital. Unlike most of the problems which were settled within the family group, the family admitted, by bringing the patient to the hospital, that the treatment of acute illness was beyond them and appropriately the doctor's sphere. They were actually participating in the patient's care because their acceptance of no visiting hours and no consultation with the doctors enabled all that time on the doctor's part to be spent in the actual treatment of the patient. Had the parents been allowed to see the patients, fewer packs could have been given because of the time involved and the confusion of additional persons around. The hospital was unusually fortunate to have a very sensitive chief of the children's service who was concerned about the individual patient, was on call at home for emergencies, and had extremely high standards for the care of each patient. Each doctor was characteristically and vitally interested in his patients. This seriousness of purpose was interpreted by the worker to families, was evident to them when they later saw the doctors, and helped tremendously in establishing their confidence in the medical care.

Support: Because it was not practical to call the doctor to discuss convalescent care until the family had arrived, the worker answered specific questions about the patient and explained the details of convalescent plans, so that she took the brunt of resentment and feelings very often before the doctor arrived. She helped the parents to open up in their minds questions which they wanted the doctor to answer and later in the interview with the doctor she helped them to raise the questions with the doctor.

In seventy-three situations, only the usual amount of support was needed through the interviews. However, in thirty-three additional instances in which the parents showed more anxiety, the worker found that she had to take a more active part. In the case of twenty-four more patients, whose parents were especially tense, anxious, unstable, and immature, support played an even larger role in enabling the fam-

ily to carry on with appropriate action. Because the worker was the only available person she was the logical one to whom the family could express its real feeling regarding the way the doctors and general staff were meeting this difficult situation. This was used by the worker to explain the cooperative teamwork of the hospital staff and this served again to renew the family's faith in the hospital.

The families in general, especially before the doctors saw them, seemed to need a leisurely interview and a longer one, in order to air their doubts and to clear up all the areas of feeling which might complicate plans later on.

The worker's function during the epidemic was basically the same as usual, but because of pressure of time the interviews had to be accelerated. Within a short period of time it became necessary for the families to work through their strong feelings of resistance and find release of tension in the interpersonal relationship offered by the worker. The general movement was quicker and directed to a more immediate goal than is characteristic of much medical social case work. Confronted by a large number of patients and a relatively short time for interviewing, the worker had to be more immediately diagnostic, in so far as possible, so that the treatment plan could be facilitated and so that a maximum of interpretative information could be given the doctors and the agency or worker responsible for ongoing case work.

During times of psychological crisis there is a very natural desire for parents to offer definite service to the patient to hasten his recovery or at least to make him more comfortable. As the patients were isolated, the parents were unable to carry out this desire. The necessity for parents to come to the place actually sheltering the person became of prime importance, so that should needs arise they could be promptly met. The reassurance of the hospital atmosphere for the time spent in it temporarily allayed anxieties and made one feel not so completely separated from the patient.

Perhaps in time of epidemic, when everyone is assuming extra duties and is overtaxed and tired, an additional supportive relationship can be given to the total hospital staff by the medical social worker. Interested listening and sympathetic identification with the problems of the staff served to release feelings and facilitate next steps to be taken in the daily job.

Interpretation: Interpretation or explanation about every phase of care of a patient with poliomyelitis within the hospital played a very great part in every interview. The more intelligent and stable parents found relief through interpretation which led to understanding and a wish to help by carrying out the recommended treatment plan.

In sixty-nine cases interpretation eased and led to comprehension readily. In sixty-one situations continued, comprehensive interpretation was needed, and in twenty-six cases repetitive, more frequent in-

terpretation reduced tension and helped toward acceptance of conditions as they were and of the convalescent plan presented.

These three techniques—use of authority, of support, and of interpretation—cannot be separated, for each upholds and strengthens the others.

The Joint Interview: The joint interview of the family with the doctor and social worker, though an old technique, proved to be particularly important for the integration and carrying out of the treatment plan when care after hospitalization was being planned.

The values to the family of the joint interview were many. The parents derived a feeling of security and support from the worker whom they knew, while the doctor divulged the progress and extent of the patient's illness and the new medical plan recommended. They tried the worker over and over again to be sure that the answers she had given before corresponded to the ones the doctor gave now. This intensified their faith in the treatment plan and teamwork within the hospital. From the doctor they were able to get the intimate daily details which only the person giving direct care to the patient could know. If the plan was for convalescent care away from home, the doctor's evaluation of why it was necessary and the worker's integration of the facilities available at the convalescent home helped to bridge a gap in the family's mind. Also, the worker was able to raise some of the points which the family had indicated a desire to explore further, but which, in the doctor's presence, they had forgotten or which they felt they could not take his time to pursue. It was at this time that the worker gave whatever background material she could insert in the family's presence, to help the doctor in his understanding of the personalities involved.

It was obvious to the workers that the presence of the doctor in the interview helped the families overcome their anxieties more easily and freed them to accept and act on the medical recommendations. When the worker alone handled the interpretation to families, many resentments came out and could not be met completely because the worker was not a doctor. Consequently his presence eased and relaxed the families, and helped make plans easier to accomplish because of the specific medical interpretation and understanding he alone was able to give.

Summary.—Medical social case work with one hundred seventy-two patients during a wartime epidemic in a civilian hospital demonstrates that there is an unusually severe emotional component in facing a diagnosis of poliomyelitis, both for the patients and their families. In the case of children, inability to see the doctor, separation from the patient, and fear of crippling run like an ever recurrent refrain through the situations faced by each child's family. Due to epidemic conditions and war-induced shortages it was impossible for the one hundred and

fifty-two families of sick children to see the patients or consult the doctor in the usual manner. Though troubled, over four-fifths of the number, following interpretation, were able to accept the recommended treatment plan in spite of these limitations, thus indicating normal adaptability. One-fifth of the group, however, had lower emotional thresholds and was able to carry out plans only with marked anxiety. Isolation from one's child and inability to discuss the child's progress with the doctor both proved very difficult for parents. Seventy-one per cent of this group seemed to accept this restriction in view of the treatment goals, while 29 per cent were less easily able to follow recommendations because their anxieties and fears were greater. Fear of crippling was implicit in every situation. Four-fifths of the group could not articulate this fear, but one-fifth verbalized it to the accompaniment of increased anxiety and reiteration of key questions.

Because of the understanding of the patient's condition which the parents had, the family was able to accept the diagnosis in all but three cases.

In contrast, case work with thirteen adults disclosed less pressure of feelings, which may be accounted for largely by the availability of the doctor to both patient and family and because the adult could understand and work through the meaning of his illness to himself, whereas the parents of the children had to take responsibility for thinking through the problem and making a decision for a dependent child.

It was obvious throughout the study that the more tense, anxious, unstable, immature persons found it more difficult to adapt to the limitations and conditions necessitated by wartime epidemic shortages. In 96 per cent of the cases the recommended treatment plan was accepted, after resistances were worked through, which would indicate the validity of the teamwork, methods, and techniques used with these patients and their families.

An important element in treatment of troubled families was the relief from financial worry made possible through financial help from the National Foundation for Infantile Paralysis.

The medical social worker's knowledge of and ability to organize and use community resources was a part of the service given.

Recommendations for the Next Epidemic or Disaster.—There were both strengths and weaknesses in the day-by-day work with this group of poliomyelitis patients under epidemic conditions. Of first importance, in future epidemics or disasters, would be preservation of the doctor-patient relationship in its usual form to reduce distress and anxiety for both patients and parents to a minimum. It is a parent's right to have information about his child, whose acute illness is a very legitimate cause for worry. Abrupt separation, though necessary because of illness and to safeguard the public health, is usually a traumatic ex-

perience for children and parents. In any subsequent epidemics it would be advisable to delegate to one individual the responsibility of giving all progress reports to relatives. If no doctor could be spared for this a medical social worker should substitute for the doctor during the crisis.

On daily rounds with the doctors she could secure information regarding the details of the patient's condition from the doctors and nurses and be available at certain hours every day for discussion of the patient's illness and care with the family. This would leave the other workers free to do more comprehensive work with each family and would give the families the feeling that medical information was available daily. The social workers could share material and have more adequate information about each patient and family group.

Our experience clearly indicates that whenever isolation precautions are necessary in hospitals, it is of primary importance that arrangements be made at least for a limited type of visiting in which the family can see, if not communicate with, the patient.

The practice of interviewing every patient's family, we feel, should be continued in times of epidemic or disasters and should be done by a person with the skills of the medical social worker. In order for the worker to give to the families the help they need, a close working relationship between doctor and medical social worker is essential. The worker is thus informed of changes in the medical plan and can prepare and help the family toward acceptance of treatment plans. Because of the difficult emotional experiences involved, it proved essential in this emergency that the medical social worker be available to the parents by telephone, for unscheduled interviews, as well as by appointment. Availability of psychiatric consultation, too, is an integral part of treatment of disturbed parents and children. A planned diversional program to prevent overactivity, boredom, and acute unhappiness on the part of the patient, is essential to obtain full benefit of the medical treatment. This experience shows that the medical social worker can be helpful in the organization and use of community resources. In order to meet the goal of individualized service to each patient and his family all hospital services must be flexible and adaptable and must work together.

The Pediatrician and the War

Dr. Ellis H. Harris, Winnetka, Ill., a Fellow of the *American Academy of Pediatrics*, is entering the Navy as Lieutenant Commander.

The following Fellows of the *American Academy of Pediatrics* have been promoted since entering service:

Army

Major Harry S. Andrews, Louisville, Ky., to Lieutenant Colonel
Captain Barnett P. Briggs, Little Rock, Ark., to Major
Captain James W. Britton, Anniston, Ala., to Major
Major Nathan H. Einhorn, Philadelphia, Pa., to Lieutenant Colonel
Major Richard G. Elliott, Lexington, Ky., to Lieutenant Colonel
Lieutenant Colonel Warren C. Fargo, Cleveland, Ohio, to Colonel
Captain Harry H. Gordon, New York, N. Y., to Major
Captain Jack R. Hild, Houston, Texas, to Major
Captain Louis Judelsohn, Buffalo, N. Y., to Major
Lieutenant J. T. Leslie, Griffin, Ga., to Captain
Captain Harold Lipton, Brooklyn, N. Y., to Major
Captain Harry Medovy, Winnepeg, Canada, to Major, Royal Canadian Army Medical Corps
Major H. H. Shuman, Fitchburg, Mass, to Lieutenant Colonel
Major Ralph E. Verploeg, Denver, Colo., to Lieutenant Colonel

Navy

Lieutenant Commander Edward D. Anderson, Minneapolis, Minn., to Commander
Surgeon-Lieutenant Harry L. Bacal, Montreal, Canada, to Surgeon-Lieutenant Commander
Lieutenant Fred W. Bush, Rochester, N. Y., to Lieutenant Commander
Lieutenant Commander Carl L. Cohen, Chicago, Ill., to Commander
Lieutenant Commander Enos P. Cook, San Jose, Calif., to Commander
Lieutenant Herman B. Marks, Central Falls, R. I., to Lieutenant Commander
Lieutenant Commander Douglas D. Martin, Tampa, Fla., to Commander
Lieutenant Commander John C. McKittrick, Burlington, Iowa, to Commander
Lieutenant Commander Councill C. Rudolph, St. Petersburg, Fla., to Commander

News and Notes

Word has been received of the death of the following Fellows of the *American Academy of Pediatrics:*

Dr. T. H. Dickinson, Dayton, Ohio.
Dr. C. Luverne Smith, Seattle, Wash. (April 23).
Dr. Jacob C. Krafft, Chicago, Ill. (March 28).
Dr. C. B. Crittenden, Louisville, Ky. (Associate Fellow).

The American Board of Pediatrics has had to change the date of the examination next fall in New York due to hotel facilities. The following schedule has been announced:

Written examination for all candidates planning to take the fall oral examinations: Friday, September 22, 1944, locally under Monitors.

Oral examinations: St. Louis, Mo., Nov. 8 and 9, 1944; New York, N. Y., Dec. 15 and 16, 1944.

Group I, which requires that an applicant shall have been specializing in pediatrics for ten years or more, will be abolished on July 1, 1944. All applicants regardless of qualifications must take both the written and oral examinations.

INDEX TO VOLUME 24

A

Abdomen, epigastric wall of, respiratory shift in, physical sign seen with complete unilateral paralysis of the diaphragm in infants and children, 627

Abler, Charles, Vollmer, H., and Rosenberg, D. A., 553

Abramson, Harold, 684

Abramson, Mason H., and Dowrie, J. O., 176, 195

Achylia, 387

Acrodynia, in a thirteen-year-old boy, 186

Adolescents, static and dynamic physical fitness of, 81

Agnese, Paul A. diSant, Larkin, V. deP., and Richter, M. N., 442

Allergy, anaphylaxis, and immunotherapy, basic principles and practice, 120 (B. Rev.)

American Academy of Pediatrics:
Proceedings, twelfth annual meeting, 109, 222, 349, 585

American Dental Association, 122 (B. Rev.)

Amino acid administration, studies of, 371

Ammon, Helen, Weaver, H. M., and Hastings, N., 88

Anaphylaxis and allergy, therapy, torantil in urticaria following serum administration, 290

Anaphylaxis, immunotherapy, and allergy, basic principles and practice, 120 (B. Rev.)

Anderson, Katherine, 186

Anemia, splenic, 335

Arendt, Julian, and Borovsky, M. P., 558

Armstrong, Janet, McGuinness, A. C., and Felton, H. M., 249

Asphyxia neonatorum, severe, late effects of, 148

Ataxia, acute, of unknown origin in children, 536

Autonomic nervous system imbalance of whole gastrointestinal tract in newborn infant, 635

B

Baby book, 121 (B. Rev.)

Bakwin, Harry, and Patrick, T. W., Jr., 405

Baldwin, Janet S., Dodge, K. G., and Weber, M. W., 483

Barnes, Donald J., Munks, B., and Kaucher, M., 159

Barnett, Henry L., Beamer, P. R., and Smith, H. L., 270

Barron, Elmer W., and Hollis, C. H., 568

Barton, Paul C., 246 (B. Rev.)

Bayrd, Edwin D., and Gibson, S., 138

Beamer, Parker R., Smith, E. B., and Barnett, H. L., 270

Best, Charles Herbert, and Taylor, N. B., 245 (B. Rev.)

Bezoar causing intestinal obstruction, 574

Bicking, Margaret M., Frohring, W. O., Toomey, J. A., Dicken, D. M., and Mitchell, W. R., 293

Biotin, pantothenic acid, and riboflavin, excretion tests in patients with poliomyelitis, 293

Blood, sedimentation rate of, white count in acute poliomyelitis, 679
white cell count, sedimentation rate, of, in acute poliomyelitis, 679

Blumberg, Marvin L., Tannenbaum, E., and Gleick, M., 182

Bonaba, J., Carrau, A., Pelfort, C., and Correa, B. D., 246 (B. Rev.)

Book reviews:
Accepted dental remedies, 122
Allergy, anaphylaxis, and immunotherapy, basic principles and practice, 120
Better Homes and Gardens baby book, 121
Dehydration, 247
Epitome of the Pharmacopeia of the United States and the National Formulary with comments, 121
Glomerulonephritis in infancy, 248
Gregg medical shorthand manual, 122
Meningitis, tuberculous, in infant, 246
New and nonofficial remedies, 122
Pharmacology, useful drugs, 246
Physiologic basis of medical practice, 245
Source book of medical history, 246
Tuberculosis congenita, 369

Borovsky, Maxwell P., and Arendt, J., 558

Boyd, Julian D., 616
Bruce, James W., and Glazer, K., 53

C

Canmann, Mark F., 335
Carrau, A., Bonaba, J., Pelfort, C., and Correa, B. D., 246 (B. Rev.)
Carril, del, Mario J., 247 (B. Rev.)
Casein, chemical uses of, and enzymatic digest of, 371
Celiac syndrome, study of serum lipids in, 417
Childhood, polyneuritis of unknown etiology in, 393
  problem in management of rheumatic disease in, 62
  rheumatic pericarditis in early, 662
Children, acute ataxia of unknown origin in, 536
  and infants, development of antibody following vaccination against pneumococci in, 641
    physical sign seen with complete unilateral paralysis of diaphragm in, respiratory shift in epigastric abdominal wall, 627
    staphylococcus empyema in, 577
  comparative toxicities of sulfadiazine and sulfathiazole in, 176
  fried food for, 199
  gonorrheal peritonitis in, 650
  Los Angeles, rheumatic fever and rheumatic heart disease in, 502
  normal, diets prescribed for, 616
  school, in New York City in 1917 and 1942, comparison of diets of, 518
  young, and infants, treatment of epidemic diarrheas and dysenteries in, 53
Chondrodystrophia calcificans congenita, 558
Clendening, Logan, 246 (B. Rev.)
Cook, Harold, and Ellenberg, S. L., 662
Cooperstock, Moses, 656
Correa, B. D., Bonaba, J., Carrau, A., and Pelfort, C., 246 (B. Rev.)
Critical Review:
  Recent advance in school health service, 470
Cross, Frank S., 191

D

Daniel, W. A., Jr., 326
Darke, Roy A., 148
Davis, David B., and Rosin, S., 502
Dehydration in pediatrics, 247 (B. Rev.)
Denzer, Bernard S., and Rosen, E., 544
Diabetes, comparison of newborn infants with erythroblastosis fetalis with those born to diabetic mothers, 603
Diaphragm, paralysis of, in infants and children, physical sign seen with complete unilateral, respiratory shift in epigastric abdominal wall, 627
Diarrhea and dysenteries, epidemic, treatment of, in infants and young children, 53
Diastase, 310
Dicken, Dorothy M., Frohring, W. O., Toomey, J. A., Bicking, M. N., and Mitchell, W. R., 293
Diets, comparison of, of school children in New York City in 1917 and 1942, 518
  milk, effect of vitamin E on reproduction in dogs on, 436
  prescribed for normal children, 616
Diphtheria toxoids combined with tetanus toxoids (aluminum hydroxide adsorbed) containing hemophilus pertussis vaccine, immunization with, 281
Dodge, Katharine G., Baldwin, J. S., and Weber, M. W., 483
Dowrie, James O., and Abramson, M. H., 176
—, Miller, J. J., Jr., and Humber, J. B., 281
Durlacher, Stanley H., Miller, H. C., and Johnson, R. D., 603
Dysentery and diarrheas, epidemic, treatment of, in infants and young children, 53

E

Eczema, infantile, dermatopathic lymphadenitis in, 442
Ellenberg, Samuel L., and Cook, H., 662
Elvehjem, C. A., Gonce, J. E., Jr., and Newell, G. W., 436
Empyema, staphylococcus, in infants and children, 577
Epstein, Harold C., Morrow, W. J., and Toomey, J. A., 623
—, Toomey, J. A., and Kriete, F. M., 290
Erythroblastosis, double ova pregnancy in which the Rh+ twin developed, 449
  fetalis, comparison of newborn infants with, with those born to diabetic mothers, 603
Evans, Charlotte J., and Lubschez, R., 518

F

Farber, Sidney, 387
Felton, Harriet M., McGuinness, A. C., and Armstrong, J. G., 249
Food, fried, for children, 199
Forbes,† Roy P., 574
Fox, Max J., and Knott, E. M., 671
Frank, William P., Rosin, S., and Hamilton, P. M., 679
Frohring, W. O., Toomey, J. A., Dicken, D. M., Bicking, M. M., and Mitchell, W. R., 293

†Deceased.

G

Gallagher, J. Roswell, 81
Gastrointestinal system, autonomic nervous system imbalance of whole, in newborn infant, 635
Gibson, Stanley, and Bayrd, E. D., 138
Glaser, Kurt, and Bruce, J. W., 53
Gleich, Morris, Blumberg, N. L., and Tannenbaum, E., 182
Glomerulonephritis in infancy, 248 (B. Rev.)
Gonce, J. E., Jr., Elvehjem, C. A., and Newell, G. W., 436
Goñi, Arturo Gaeza, 248 (B. Rev.)
Gonococcus, gonorrheal peritonitis in children, 650
Grant, Alice A., 691
Granuloma, sublingual, 195
Gynecology, pediatrics, panel discussion on, 222

H

Hamilton, Paul M., Rosin, S., and Frank, W. P., 679
Hansen, Arild E., and Luzziatti, L., 417
Hardwicke, Sarah Hooker, 259
Hartmann, Alexis F., Lawler, H. J., and Meeker, C. S., 371
Hastings, Norma, Ammon, H., and Weaver, H. M., 88
Hatcher, Robert A., 246 (B. Rev.)
Hatoff, Alexander, 393
Health problems in children: Mental and psychologic management of infants (Round table discussion), 585
Heart, disease, rheumatic, and rheumatic fever in Los Angeles children, 502
  interventricular septum of, traumatic, 138
  traumatic injury of, in child, 138
Height, weight, and appearance of ossification centers, seasonal variations in, 524
Hematoma, subdural, in infancy, 1
Hemophilus pertussis, vaccine from, contained in combined diphtheria and tetanus toxoids (aluminum hydroxide adsorbed), immunization with, 281
Histaminase in urticaria, 290
Histoplasmosis, 270
History, medical, source book of, 246 (B. Rev.)
Hodes, Horace L., Ziegler, J. F., Jr., and Zepp, H. D., 641
Hodges, Richard G., and Klingman, W. O., 536
Hollis, Charles H., and Barron, E. W., 568
Hospital nurseries for newborn infants, role of surgical mask in prevention of cross-infections in, 684
Humber, Jeanette B., Dowrie, J. O., and Miller, J. J., Jr., 281
Huschka, Mabel, 206
Hypoprothrombinemia in newborn infant, studies on minimal effective dose of water-soluble vitamin K substitute in prevention of, 259

I

Ileus, 574
Infancy, glomerulonephritis in, 248 (B. Rev.)
  subdural hematoma in, 1
  sublingual granuloma in (Riga-Fede's disease), 195
  tularemia in, 326
Infant, and children, development of antibody following vaccination against pneumococci, 641
  physical sign seen with complete unilateral paralysis of diaphragm in, respiratory shift in epigastric abdominal wall, 627
  staphylococcus empyema in, 577
  and young children, treatment of epidemic diarrheas and dysenteries in, 53
  Negro, weight of, 405
  newborn, autonomic nervous system imbalance of whole gastrointestinal tract in, 635
  role of surgical mask in prevention of cross-infections in hospital nurseries for, 684
  serum diastase in, 310
  studies on minimal effective dose of water-soluble vitamin K substitute in prevention of hypoprothrombinemia in, 259
  with erythroblastosis fetalis, comparison of, with those born to diabetic mothers, 603
  psychologic management of, and mental health problems in children (Round table discussion), 585
  rachitic, effect of vitamin D from cod-liver oil and tuna-liver oil upon serum phosphatase concentrations in, 159
  rheumatic pericarditis with effusion in, 514
Ingraham, Franc D., and Matson, D. D., 1
Intestine, obstruction of, caused by bezoar, 574

J

Jaundice, epidemic of common infections, 454
Johnson, Roswell D., Miller, H. C., and Durlacher, S. H., 603

K

Kabat, Herman, and Knapp, M. E., 123
Kaucher, M., Barnes, D. J., and Munks, B., 159
Klingman, Walter O., and Hodges, R. G., 536
Knapp, Miland E., and Kabat, H., 123

Knott, Elizabeth M., and Fox, M. J., 671
Kriete, Frederic M., Toomey, J. A., and Epstein, H. C., 290
Krost, Gerard N., 514, 635

L

Lamm, Stanley S., and Shulman, B. H., 408
Lapin, Joseph H., 331
Larguia, Alfredo E., 247 (B. Rev.)
Larkin, Vincent de Paul, Agnese, P. A. diS., and Richter, M. N., 442
Lawler, Harry J., Hartmann, A. F., and Meeker, C. S., 371
Lepper, Mark H., and Sweet, L. K., 295
Leucemia, congenital, 191
Light, Jacob S., 627
Los Angeles, children in, rheumatic fever and rheumatic heart disease in, 502
Love, Selby V., 312
Lubschez, Rose, and Evans, C. J., 518
Luzzatti, Luigi, and Hansen, A. E., 417
Lymphadenitis, dermatopathic, in infantile eczema, 442

M

Maguire, Daniel L., Jr., 650
Mask, surgical, role of, in prevention of cross-infections in hospital nurseries for newborn infants, 684
Matson, Donald D., and Ingraham, F. D., 1
McGuinness, Aims C., Armstrong, J. G., and Felton, H. M., 249
McLeod, Kenneth W., 454
Medicine, practice of, physiological basis of, 245 (B. Rev.)
Meeker, Cornelius S., Hartmann, A. F., and Lawler, H. J., 371
Meningitis, acute serous, in scarlet fever, 295
due to salmonella oranienburg, 568
influenzal, 408
advance in chemotherapy of, 182
tuberculous, in infant, 246 (B. Rev.)
promin in treatment of, 623
Meningococcus infection, fulminating (Waterhouse-Friderichsen syndrome), 675
Miller, Herbert C., Johnson, R. D., and Durlacher, S. H., 603
Miller, John J., Jr., Dowrie, J. O., and Humber, J. B., 281
Mitchell, Winifred R., Frohring, W. O., Toomey, J. A., Dicken, D. M., and Bicking, M. M., 293
Morrow, William J., Epstein, H. C., and Toomey, J. A., 623
Mothers, diabetic, comparison of newborn infants with erythroblastosis fetalis with those born to, 603
Munks, Bertha, Barnes, D. J., and Kaucher, M., 159
Muscle, spasm of, in poliomyelitis, mechanism of, 123

N

National formulary and the pharmacopeia of the United States, epitome of, with comments, 121 (B. Rev.)
Negro infants, weight of, 405
Neuritis in childhood, unknown, etiology of, 393
Newell, G. W., Elvehjem, C. A., and Gonce, J. E., Jr., 436
New York City, school children in, in 1917 and 1942, comparison of diets of, 518
News and notes, 120, 244, 369, 482, 601, 724
Niemann-Pick disease, 335

O

Ossification, centers of, seasonal variations in weight, height, and appearance of, 524
Outpatient department, psychiatric consultation service in a pediatric, 206

P

Palsy, cerebral, congenital (*See* Paralysis, spastic)
Pancreas, secretion of, 387
Panel discussion on pediatric gynecology, 222
Pantothenic acid, riboflavin, and biotin excretion tests in patients with paralytic poliomyelitis, 293
Paralysis, spastic, etiology of, 38
Patrick, Thomas W., Jr., and Bakwin, H., 405
Pediatrician and the war, 106, 600, 724
Pelfort, C., Bonaba, J., Carrau, A., and Correa, B. D., 246 (B. Rev.)
Pericarditis, purulent, complicating pneumonia, recovery in infant following therapeutic aspiration and the development of pneumopericardium, 656
rheumatic, in early childhood, 662
with effusion, under two years of age, 514
Peritonitis, gonorrheal, in children, 650
Pharmacology, useful drugs, 246 (B. Rev.)
Pharmacopeia of the United States and the National Formulary, epitome of, with comments, 121 (B. Rev.)
Physiology, basis of, in medical practice, 245 (B. Rev.)
Pneumococci, development of antibody following vaccination of infants and children against, 641

Pneumonia, purulent pericarditis complicating, recovery in infant following therapeutic aspiration and the development of pneumopericardium, 656
treatment of, with single dose of sulfadiazine, 553
Pneumopericardium, development of, recovery in infant following therapeutic aspiration; purulent pericarditis complicating pneumonia, 656
Poliomyelitis, acute, sedimentation rate and white blood count in, 679
epidemic of, medical social work in, 691
mechanism of muscle spasm in, 123
paralytic, riboflavin, pantothenic acid, and biotin excretion tests in patients with, 293
virus of, effect of rachitogenic diets, partial inanition, and sex on the resistance of cotton rats to, 88
Potter, Edith L., 449
Pregnancy, double ova, in which the Rh+ twin developed erythroblastosis, 449
Promin in treatment of tuberculous meningitis, 623
Psychiatry, pediatric outpatient department, consultation service in, 206

R

Rabies, paralytic, 312
Ratbite fever caused by streptobacillus moniliformis, 544
Ratner, Bret, 120 (*B. Rev.*)
Remedies, dental accepted, 122 (*B. Rev.*)
new and nonofficial, 1943, 122 (*B. Rev.*)
Reproduction in dogs on milk diets, effect of vitamin E on, 436
Respiration, shift in epigastric abdominal wall, physical signs seen with complete unilateral paralysis of the diaphragm in infants and children, 627
Reynolds, Earle L., and Sontag, L. W., 524
Rheumatic fever and rheumatic heart disease in Los Angeles children, 502
prophylactic use of sulfanilamide in children with inactive, 483
in childhood, problems in management of, 62
pericarditis in early childhood, 662
Richardson, Frank Howard, 199
Richman, Ellen Ehrenfest, and Salmon, G. W., 310
Richter, Maurice N., Agnese, P. A. diS., and Larkin, V. deP., 442
Rickets, further observations on use of single massive doses of vitamin D in prevention of, 167
Riga-Fede's disease, 195
Riley, Conrad M., 577
Rosen, Edgar, and Denzer, B. S., 544
Rosenberg, David A., Vollmer, H., and Abler, C., 553
Rosin, Sidney, and Davis, D. B., 502
—, Frank, W. P., and Hamilton, P. M., 679
Round table discussion:
psychologic management of infants and mental health problems in children, 585
sinusitis in children, 349
state chairmen's, 109

S

Salmon, George W., and Richman, E. E., 310
Salmonella oranienburg, meningitis due to, 568
Scarlet fever, acute serous meningitis in, 295
School health service, recent advances in, 470 (Critical Rev.)
Serum, administration of, torantil in urticaria following, 290
diastase, 310
lipids in celiac syndrome, study of, 417
phosphatase concentrations in rachitic infants, effect of vitamin D from cod-liver oil and tuna-liver oil upon, 159
Shorthand, medical, Gregg, manual, 122 (*B. Rev.*)
Shulman, Bernard H., and Lamm, S. S., 408
Shultz, Gladys, 121 (*B. Rev.*)
Sinusitis in children (Round table discussion), 349
Smith, Austin E., 122 (*B. Rev.*)
Smith, Edward B., Barnett, H. L., and Beamer, P. R., 270
Smither, Effie B., 122 (*B. Rev.*)
Social work, medical, in epidemic poliomyelitis, 691
Sontag, Lester W., and Reynolds, E. L., 524
State chairmen (Round table discussion), 109
Streptobacillus moniliformis, ratbite fever caused by, 544
Strick, Marvin H., 675
Sulfadiazine and sulfathiazole in children, comparative toxicities of, 176
treatment of pneumonia with single dose of, 553
Sulfanilamide, prophylactic use of, in children with inactive rheumatic fever, 483
Sulfathiazole and sulfadiazine in children, comparative toxicities of, 176
Sweet, Lewis K., and Lepper, M. H., 295

T

Tannenbaum, Elk, Blumberg, M. L., and Gleich, M., 182
Taran, Leo M., 62
Taylor, Norman Burke, and Best, C. H., 245 (*B. Rev.*)
Tetanus toxoids and diphtheria toxoids combined (aluminum hydroxide adsorbed) containing pertussis hemophilus vaccine, immunization with, 281
Toomey, John A., Morrow, W. J., and Epstein, H. C., 623
—, Frohring, W. O., Dicken, D. M., Bicking, M. M., and Mitchell, W. R., 293
—, Kriete, F. M., and Epstein, H. C., 290
Torantil, 290
Toxoid, diphtheria, alum-precipitated, clinical modification of whooping cough by use of, 46
Tuberculosis congenita, 369 (*B. Rev.*)
Tularemia in infancy, 326
Turnbull, Jorge Muñoz, 46
Twin, Rh+, double ova pregnancy in which erythroblastosis was developed in, 449

U

Urticaria following serum administration, torantil in, 290

V

Vaccination, development of antibody following, of infants and children against pneumococci, 641
Varela, Gerardo, 46
Vitamin D from cod-liver oil and tuna-liver oil, effect of, upon serum phosphatase concentrations, in rachitic children, 159
  in prevention of rickets, further observations on use of single massive doses of, 167
Vitamin—Cont'd
  E, effect of, on reproduction in dogs on milk diets, 436
  K water-soluble substitute, minimal effective dose of, in prevention of hypoprothrombinemia in newborn infant, studies of, 259
Vollmer, Hermann, Abler, C., and Rosenberg, D. A., 553

W

Waissmann, Mario, 369 (*B. Rev.*)
War, pediatrician and, 106, 600, 724
Waterhouse-Friderichsen syndrome, fulminating meningococcemia, 675
Weaver, H. M., Ammon, H., and Hastings, N., 88
Weber, Mortimer W., Dodge, K. G., and Baldwin, J. S., 483
Weight, height, and appearance of ossification centers, seasonal variations in, 524
  of Negro infants, 405
Wheatley, George M., 470
Whooping cough, clinical modification of, by use of alum-precipitated diphtheria toxoid, 46
  control of, 331
  hyperimmune serum for, 249
  mortality of, 671
Wolf, I. J., 167

X

Xanthomatosis, acute idiopathetic, 335

Y

Yannet, Herman, 38

Z

Zepp, Helen D., Hodes, H. L., and Ziegler, J. F., Jr., 641
Ziegler, James F., Jr., Hodes, H. L., and Zepp, H. D., 641

The Journal of Pediatrics

CONTENTS FOR JUNE, 1944

Original Communications

A Comparison of Newborn Infants With Erythroblastosis Fetalis With Those Born to Diabetic Mothers. Herbert C. Miller, M.D., Roswell D. Johnson, M.D., and Stanley H. Durlacher, M.D., New Haven, Conn. ---- 603

Prescribed Diets for Normal Children. Julian D. Boyd, M.D., Iowa City, Iowa ---- 616

Promin in the Treatment of Tuberculous Meningitis. William J. Morrow, M.D., Harold C. Epstein, M.D., and John A. Toomey, M.D., Cleveland, Ohio ---- 623

Respiratory Shift in Epigastric Abdominal Wall—A Physical Sign Seen With Complete Unilateral Paralysis of the Diaphragm in Infants and Children. Jacob S. Light, M.D., Baltimore, Md. ---- 627

Autonomic Nervous System Imbalance of the Whole Gastrointestinal Tract in the Newborn Infant. Gerard N. Krost, M.D., Chicago, Ill. ---- 635

Development of Antibody Following Vaccination of Infants and Children Against Pneumococci. Horace L. Hodes, M.D., James F. Ziegler, Jr., M.D., and Helen D. Zepp, Baltimore, Md. ---- 641

Gonorrheal Peritonitis in Children. Daniel L. Maguire, Jr., M.D., Charleston, S. C. ---- 650

Purulent Pericarditis Complicating Pneumonia. Moses Cooperstock, M.D., Marquette, Mich. ---- 656

Rheumatic Pericarditis in Early Childhood. Samuel L. Ellenberg, M.D., and Harold Cook, M.D., New York, N. Y. ---- 662

Whooping Cough Mortality. Max J. Fox, M.D., and Elizabeth M. Knott, Ph.D., M.D., Milwaukee, Wis. ---- 671

Fulminating Meningococcemia (The Waterhouse-Friderichsen Syndrome). Marvin H. Strick, M.D., Chicago, Ill. ---- 675

The Sedimentation Rate and White Blood Count in Acute Poliomyelitis. Sidney Rosin, M.D., William P. Frank, M.D., and Paul M. Hamilton, M.D., Los Angeles, Calif. ---- 679

The Role of the Surgical Mask in the Prevention of Cross-Infections in Hospital Nurseries for Newborn Infants. Harold Abramson, M.D., New York, N. Y. ---- 684

Medical Social Work in an Epidemic of Poliomyelitis. Alice A. Grant, Medical Social Worker, New Haven Hospital, New Haven, Conn. ---- 691

The Pediatrician and the War

List of the Fellows of the American Academy of Pediatrics Who Have Been Promoted Since Entering the Military Services---- 724

News and Notes

News and Notes ---- 724

Index

Index ---- 725

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